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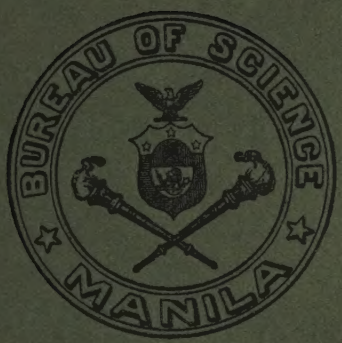

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THE PHILIPPINE
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STUDIES ON PHILIPPINE ORCHIDS, I

By EDUARDO QUISUMBING

Curator, Philippine National Herbarium, Bureau of Science, Manila

SEVEN PLATES

The present contribution is the result of further studies of those orchids in the Philippines that appear to deserve recognition as being new or interesting. One genus (*Poaephyllum*) and two species (*Dendrobium macrophyllum* and *Dendrobium quadrisulcatum*), which have been described previously, are for the first time credited to the Philippines with certainty. *Dendrobium ternatense* is redescribed here. Four species are here proposed as new. All illustrations and descriptions have been prepared from living specimens, except the description of *Poaephyllum grandiflorum* and *Dendrochilum Edanoi* which are based on herbarium specimens. The colored illustrations were made by Mr. Pedro Ramos and the ink sketches by Messrs. V. V. Marasigan and R. C. Aguilar, all of the National Museum, Bureau of Science. Unless otherwise indicated in the text, the types of the new species have been deposited in the Philippine National Herbarium, Bureau of Science, Manila.

Genus DENDROCHILUM Blume

DENDROCHILUM EDANOI Quisumbing sp. nov.

Aff. *D. Clemensiæ* Ames. Pseudobulbi fusiformes, 3 ad 4 cm longi; vaginae elongatae, tubulares. Folium cum petiolo 12.5 ad 15.7 cm longum; lamina 11 ad 14 cm longa, 2.8 ad 3.3 cm lata, oblongo-lanceolata, acuta, in sicco chartacea, 7-nervia. Pedunculus gracilis, 3 ad 4 cm longus. Inflorescentia cum

pedunculo 17.5 ad 34.5 cm longa. Flores 24 ad 65, distichi, 4 ad 5 mm distantes. Bracteae 3 ad 4 mm longae, ovatae, acutae. Sepala lateralia oblongo-lanceolata, acuta, 6.75 ad 7 mm longa, 2 ad 2.25 mm lata, 3-nervia. Sepalum dorsale oblongo-lanceolatum, 6.5 ad 6.75 mm longum, circiter 2 mm latum, acutum. Petala anguste oblongo-lanceolata, acuta, circiter 6.5 mm longa, 1.5 mm lata, 3-nervia. Labellum 3-lobatum, circiter 6 mm longum; lobi laterales parvi, angustæ triangulares, acuminati; lobus medius subrotundatus, obtusus, circiter 3 mm longus, 2 mm latus; discus inferne cum 2 lamellis. Columna gracilis; alae laterales oblique truncatae, circiter 2 mm longae; lobus terminalis late obtusa et irregulariter minute denticulata.

Pseudobulbs fusiform, 3 to 4 cm long; sheath elongate, tubular. Leaves with petioles, 12.5 to 15.7 cm long; lamina oblong-lanceolate, acute, 11 to 14 cm long, 2.8 to 3.3 cm wide, chartaceous when dry, 7-nerved. Peduncle very slender, 3 to 4 cm long. Flowers white, 24 to 65, distichous, 4 to 5 mm distant. Bracts 3 to 4 mm long, ovate, acute. Lateral sepals oblong-lanceolate, acute, 6.75 to 7 mm long, 2 to 2.25 mm wide, 3-nerved. Dorsal sepal similar in shape to lateral sepals, 6.5 to 6.75 mm long, about 2 mm wide, 3-nerved. Petals narrowly oblong-lanceolate, acute, about 6.5 mm long, 1.5 mm wide, 3-nerved. Labellum 3-lobed, about 6 mm long; lateral lobes small, narrowly triangular, acuminate; middle lobe when expanded subrotund, obtuse, about 3 mm long, 2 mm broad, disc with 2 long lamellæ. Column elongate, slender, lateral wings simple, obliquely truncate, about 2 mm long, on the species I examined about 2 mm long; upper lobe elongate, broadly obtuse and minutely denticulate or erose.

PALAWAN, Mount Gantung, *Bur. Sci. 77914 G. Edaño*, May 8, 1929.

Dendrochilum Edanoi is allied to *D. Clemensiæ* Ames, but differs from the latter in having a shorter column and especially in the obtuse terminal lobe. *D. papillosum* J. J. Sm. is apparently allied to the present species, but differs from it in having broader sepals and petals and a dissimilar midlobe of lip. *D. tardum* J. J. Sm. has a longer peduncle, a shorter raceme, an acute midlobe of lip, and acuminate column arms which are simple at the tip.

This species is named in honor of Mr. Gregorio Edaño, for almost three decades a botanical collector of the Philippine National Herbarium, Bureau of Science.

Genus DENDROBIUM Swartz

DENDROBIUM (subg. PEDILONUM) GONZALESII Quisumbing sp. nov. Plate 1, figs. 5 to 8; Plate 2, figs. 1 to 14.

Aff. *D. victoriæ-reginæ* Loher. Caules fasciculati, penduli, parce ramosi, 40 ad 55 cm longi, foliosi; internodia cylindracea, 1 ad 1.5 cm longa, fibrillis vaginarum macrescentium vestita. Folia oblongo-lanceolata vel lanceolata, acuta, 5 ad 9.5 cm longa, 1.2 ad 1.8 cm lata, nervosa, papyracea. Racemi pauciflori (1- ad 3-flori); bracteæ parvæ, membranaceæ, oblongæ, acutæ, 5 ad 6 mm longæ. Sepala lateralia lineari-lanceolata, acuta, 2.5 ad 2.6 cm longa, circiter 6 mm lata, 5-nervia, mentum curvatum cylindraceum formantia. Sepalum dorsale anguste oblongum, acutum, 2.2 ad 2.3 cm longum, circiter 5 mm latum, 5-nervum. Petala anguste oblonga, acuta, 2.4 ad 2.5 cm longa, 4.5 ad 5 mm lata, 5-nervia. Labellum simplex, anguste oblongum, acutum, 2.8 ad 2.9 cm longum, 7 ad 8 mm latum, 7-nervium, laeve. Gynostemium perbreve, carnosum, circiter 3 mm longum, in pedem extensum; stelidia erecta, lateralia obtusa, stelidium medium subulatum.

Habit of *D. chameleon* Ames and *D. victoriæ-reginæ* Loher. Stems fascicled, slender, pendulous, 40 to 55 cm long; branches few, jointed, nodes swollen, internodes 1 to 1.5 cm long. Leaves oblong-lanceolate, or lanceolate, acute, 5 to 9.5 cm long, 1.2 to 1.8 cm wide, papyraceous, nervose when dry. Racemes few-flowered (1- to 3-flowered); bracts oblong, acute, 5 to 6 mm long, membranaceous. Flowers odorless, showy; pedicellate ovary slender. Lateral sepals linear-lanceolate, acute, 2.5 to 2.6 cm long, about 6 mm wide, 5-nerved, forming a conspicuous slender, cylindrical curved mentum, when stretched out 1.4 to 1.5 cm long. Dorsal sepal narrowly oblong, acute, 2.2 to 2.3 cm long, about 5 mm wide, 5-nerved. Petals narrowly oblong, acute, 2.4 to 2.5 cm long, 4.5 to 5 mm wide, 5-nerved. Labellum simple, narrowly oblong, acute, 2.8 to 2.9 cm long, 7 to 8 mm wide, 7-nerved, flat, devoid of any raised lines or calli. Column very short, stout, fleshy, about 3 mm long; lateral arms erect, obtuse, middle one subulate.

LUZON, Manila, Mrs. Remedios C. Gonzales' garden, *Phil. Nat. Herb. 3451 Eduardo Quisumbing*, September 12, 1935. Plants were originally collected by Mr. and Mrs. Jose Salvador Gonzales from Mayon Volcano, Albay Province, Luzon, at an altitude of about 860 meters, growing on tree trunks. Sepals and petals

white, edged with pale amaranth pink; lip white; lined at the base with aster purple, and edged with faint glass green except the tip; spur white, tipped with glass green; column white.

A species closely allied to *Dendrobium victoriæ-reginæ* Loher, differing in its curved spur and in its narrowly oblong labellum.

The species is dedicated to Mr. Jose Salvador Gonzales, Assistant Chief Engineer of the City of Manila, and a lover of orchids.

Another plant, *Phil. Nat. Herb. 3452 Eduardo Quisumbing*, September 12, 1935, found growing on the same tree as the species, must be referred to this species. It differs in its mauve and larger flowers and the obovate labellum.

DENDROBIUM MACROPHYLLUM A. Richard. Plate 1, figs. 3 and 4; Plate 3, figs. 1 to 11; Plate 7, figs. 1 and 2.

Dendrobium macrophyllum A. RICH., Sert. Astrol. (1834) 22, *t. 9;* REICHB. F. in Walp. Ann. 6 (1861) 304; Illustr. Hortic. 35 (1888) 59, *t. 57;* WILL., Orch. Album 8 (1889) *t. 339*, Orch. Grow. Man. ed. 7 (1894) 349; J. J. SM., Fl. Buitenz. 6 (Orch.-Jav.) (1905) 347; Orch. Ambon. (1905) 55; AMES, Orch. 2 (1908) 179; KRÄNZL. in Eng. Pflanzenreich IV 50 II 21 (1910) 244, *fig. 20. D-E;* SCHLTR., Die Orchideen (1927) 263.

Dendrobium Veitchianum LINDL., Bot. Reg. (1847) sub. *t. 25;* DE VRIESE, Illustr. Orch. Ind. Neerl. (1852) *t. 5 et t. 18 fig. 3;* PAXT., Mag. Bot. 14 (1847) 115; REICHB. F. in Walp. Ann. 1 (1849) 778, in Bonpl. 5 (1857) 56; MIQ., Fl. Ind. Bat. 3 (1859) 632; MÜLLER, Desc. Notes Pap. Plts. 30.

Dendrobium macrophyllum A. Rich var. *Veitchianum* HOOK. F. in Bot. Mag. (1867) *t. 5649;* WILLIAMS, Orch. Grow. Man. ed. 7 (1891) 349; SANDER, Orch. Guide (1927) 180; VEITCH, Man. Orch. Pl. pt. 3 (1888) 60.

Dendrobium ferox HASSK., Retzia 1 (1885) 1.

Dendrobium polysema SCHLTR. in Schum. Lauterb. Nachtr. Fl. Deutsch. Schutzgeb. (1905) 163.

Dendrobium sarcostoma TEIJSM. & BINN., Ms. Ex. Miq. Fl. Ind. Bat. 3 (1859) 637.

Callista Veitchiana O. K., Rev. Gen. Pl. (1891) 655.

The original description reads as follows:

Foliis amplis elliptico-oblongis, acutis, coriaceis, *scapo* simplici; floribus magnis spicatis; *spica* longa interrupta; *pedicellis ovarioque* hispidis, *bractea* persistenti lanceolata glabra longioribus; laciniis externis pilosis; interioribus spathulatis acuminatis; *labello* perfunde trilobo, concavo, basi unguiculato. Nob. *Crescit* in Nova-Guinea.—RICHARD, *loc. cit.*

Stems erect, fascicled, base narrowed, somewhat flattened, deeply grooved, 30 to 42 cm high, 2 to 2.5 cm in diameter, 2- to 3-leafed. Leaves oblong-elliptic, acute, leathery, 22.5 to 25.5

cm long, 4.5 to 7.5 cm wide. Racemes longer than leaves, 35.5 to 44 cm long including peduncles, somewhat nodding at apex, 16- to 18-flowered; peduncles 15.5 to 18 cm long; bracts membranaceous, lanceolate, acute, 2.5 to 3.2 cm long, 1 to 1.3 cm wide when expanded at widest portion, smaller at apex of raceme; pedicellate ovary setigerous, 3 to 4.8 cm long. Flowers somewhat fragrant, 5 to 6 cm across. Lateral sepals falcate, externally setigerous, triangular, lanceolate, acutely acuminate, 2.5 to 2.8 cm long, 9.5 to 10.5 cm wide. Dorsal sepal oblong, externally setigerous, acutely acuminate, 2.7 to 3.2 cm long, 1 to 1.1 mm wide. Spur not conspicuous, 10 to 11 mm long. Petals spathulate, acute, glabrous, 2.5 to 3 cm long, 10 to 11.5 mm wide. Labellum deeply 3-lobed; lateral lobes erect, broadly cuneate, 1.2 to 1.3 cm high, 1.3 to 1.5 cm wide; middle lobe concave, subreniform, apiculate, 1.2 to 1.3 cm long, 2 to 2.2 cm wide when expanded; in the disc in front of the narrow claw a thick, fleshy callus; column short, fleshy, 3 to 4 mm long.

LUZON, Manila, Mrs. Remedios C. Gonzales' garden, *Phil. Nat. Herb. 3452 Eduardo Quisumbing*, March 16, 1936. The plant was purchased in Manila from Mr. W. Parsons, who claimed that it was originally collected in the Mountain Province.

Peduncles kildare green; bracts glass green, base paler; sepals chalcedony yellow with few blackish red-purple dots on the back; petals citron yellow with few blackish purple dots; lateral lobes of lip lumiere green with radiating bordeaux streaks; middle lobe lumiere green with a few radiating lines of blackish red-purple dots; callus white; column lumiere green; anther spinach green.

My material is without doubt *D. macrophyllum* A. Rich. While it is a recently discovered addition to the Flora of the Philippines, it is one of our handsomest species. Borneo, Java, Amboina, Ternate, New Guinea. *Dendrobium macrophyllum* differs from *D. ternatense* J. J. Sm. in its much larger stems, larger flowers, and in other floral details.

DENDROBIUM QUADRISULCATUM J. J. Sm. Plate 4, figs. 1 to 12.

Dendrobium quadrisulcatum J. J. SM. in Bull. Jard. Bot. Buitenz. XI 25 (1917) 49, Icones Orch. Malay II Suppl. 2 (1934) *t. 85 III.*

The original description reads as follows:

DENDROBIUM (sect. Distichophyllum) QUADRISULCATUM J. J. S. n. sp.

Caules approximati, erecti, plus minusve quadrangulares, inferne teretes, sicco alte 4 sulcati, c. 20–45 cm. longi, dense distiche foliati, internodiis ad

c. 1.8 cm. longis, superioribus ad c. 0.5 cm. reductis. Folia patentia, basi semitorta, oblonga ad oblongo-linearia, oblique obtuse biloba, supra impressione lanceolato-ovato-triangula notata, coriacea, c. 2-4.5 cm. longa, 0.55–1 cm. lata; vaginae tubulosae, internodia superantes. Inflorescentiae ad nodos caulium, 2 vaginas perforantes, 1 florae, pedunculo brevissimo, non nullis vaginulis acutis donato. Flores minusculi. Sepalum dorsale reflexum, ovato-triangulum, acuminatum, acutum, convexum, c. 0.83 cm. longum, 0.44 cm. latum. Sepala lateralia lacinia oblique triangulare ad pedem gynostemii decurrentia, mentum conicum obtusum c. 0.7 cm. longum formantia, reflexa ad recurva, parte antica oblique oblongo-triangula, acuminata, acuta, convexa, c. 0.9 cm. longa, basi 1 cm. lata. Petala oblique reflexa, oblique ovata, supra medium contracta, acuminata, acuta, convexa, basi 3-nervia, c. 0.9 cm. longa, 0.46 cm. lata. Labellum basi longitudine c. 0.55 cm. pedi gynostemii adnatum, e basi cuneata valde dilatatum, 3 lobum, crasse carnosum, intus costis 2 longitudinalibus crasse carnosis subverruculosis intermedii, apice costula tertia brevi alta rotundato-lamelliformi interposita, explanatum totum c. 1.9 cm. longum, ad lobos laterales 2 cm. latum, ungue c. 0.5 cm longo; lobi laterales subpatentissimi, oblique oblongi, obtusissimi, convexi, c. 0.6 cm. longi, medio 0.4 cm. lati; lobus intermedius magnus, late transverse suboblongus, utrinque obtusus, apice latissime rotundatus medio retusus, marginibus lateralibus recurvis, crassus c. 0.9 cm. longus, 1.73 cm. latus. Gynostemium c. 0.46 cm. longum, auriculis obtusissimis, quam antheram brevioribus. Anthera cucculata, dorso impressa, apice truncata et puberula. Pes gynostemii c. 0.75 cm. longus. Ovarium c. 0.6 cm. longum; pedicellus c. 1.2 cm. longus.

Borneo; Goenoeng Damoes. (H. Hallier 1893, n. 563, type). Goenoeng Kenepai. (H. Hallier 1893, n. 2450). Amai Ambit. (H. Hallier 1894, n. 3425).

This belongs to a small group of species of the section Distichophyllum with a deeply divided labellum, narrow side lobes and a broad midlobe, as f. e. *D. xanthophaeum* Schltr. from New-Guinea and *D. kenepaiense* J. J. Sm. In the form of the keels on the lip it much resembles *D. xanthophaeum*, but has ovate acute petals and very blunt side lobes of the lip.

Description from herbarium specimens.

In habit similar to the closely allied *D. uniflorum* Griff. Stems erect, foliose, more or less 4-angled, basal portion terete and smaller, 25 to 35 cm long, sheaths distinctly ridged; internodes 1.5 to 2 cm long, upper internodes reduced. Leaves linear-lanceolate, unequally bilobed at the narrowed apex, subcoriaceous, 3 to 7 cm long, 4 to 6 mm wide. Inflorescence 1-flowered, appearing at nodes; peduncles very short. Lateral sepals obliquely triangular-ovate, shortly acuminate, acute, 1 to 1.1 cm long, 6.5 to 6.8 mm wide, 5-nerved; spurlike mentum conical, obtuse, slightly recurved. Dorsal sepal reflexed, triangular-ovate, shortly acuminate, acute, about 1 cm long, 6 to 7 mm wide, 5-nerved. Petals obliquely reflexed, narrowly oblong-lanceolate, acute, about 1 cm long, 3.3 mm wide, 3-nerved. Labellum 3-

lobed, about 1.6 cm long; lateral lobes obliquely oblong, obtuse, about 8 mm long; middle lobe broad, subquadrate when expanded, broadly obtuse or retuse, sides recurved, about 1 cm long, 1.6 cm wide. Column thick, fleshy, about 6 mm long, with short obtuse auricles.

MINDANAO, Zamboanga Province, Zamboanga, *Phil. Nat. Herb. 3453 Mrs. K. B. Day*, June 24, 1935, flowers yellowish.

Our specimen matched well with the species, differing slightly in having longer and narrower leaves and in its narrower petals.

DENDROBIUM TERNATENSE J. J. Sm. Plate 1, figs. 1 and 2; Plate 3, figs. 12 to 21; Plate 6. figs. 1 and 2.

Dendrobium ternatense J. J. SM. in Bull. Dept. Agr. Ind. Neerl. 22 (1909) 25; KRÄNZL. in Engl. Pflanzenreich IV 50 II B 21 (1910) 246, *fig. 20 A-C;* AMES, Orch. 5 (1915) 139; in Merr. Enum. Philip. Fl. Pl. 1 (1924) 356.

Dendrobium macrophyllum A. RICHARD acc. to Ames Orch. 2 (1908) 179; KRÄNZL. in Engl. Pflanzenreich IV 50 II B 21 (1910) 244, quoad Philip.

The original description reads as follows:

Caules approximati, elongati, clavati, 2/5 partibus inferioribus tenues, superne incrassati, apicem versus attenuati, sectione transverse elliptici, 4–5 nodes, internodio ultimo maximo, profunde sulcati, olivacei, adulti atrofusci, ad c. 18 cm. long., 1.75 cm. lati, initio vaginis magnis tubulosis tecti, apice 2-folii. Folia e basi erecta divaricata, oblonga, apice acute bidentata, costa media supra sulcata, subtus prominente, coriacea, supra nitida viridia, subtus opaca pallidiora, c. 15 cm. longa, 4.5-5 cm. lata. Inflorescentiae pseudo-terminales, laxe pauciflorae. Bracteae ovatae, acutae, valde concavae, glabrae, dilute flavo-virides, c. 1.5 cm. longae, 1.35 cm. latae. Flores majusculi, c. 3-3.7 cm. diam., sepalis dorso carnoso-pilosis petalisque dilute viridiflavis, dorso minute sordide violaceo-maculatis, deinde aureis. Sepalum dorsale ovato-triangulum, acuminatum, acutum, conico-apiculatum, concavum, 5-nervium, c. 1.85 cm. longum, fere 1 cm. latum. Sepala lateralia cum pede gynostemii mentum breve, rectum, obtussissimum formantia, oblique triangula, longium subulato-acuminata, 5-nervia, c. 2 cm. longa, 1.15 cm. lata. Petala leviter curvata, marginibus inferne recurvis, superne incurvis, unguiculata, oblongo-elliptica, acuminata, acuta, 3-nervia, c. 175 cm. longa, ungue c. 0.27 cm. lato, lamina c. 1.35 cm. longa, 0.575 cm. lata. Labellum breviter unguiculatum, 3-lobum, carnosum, inter lobos laterales callo longitudinali, breviusculo, rectangule oblongo, 3-costato, antice 3-lobulato, postice in lamellam bilobam dilatato, edentato, sulcato et marginibus posticis loborum lateralium basi tantum adnato, niveo donatum, expansum totum c. 1.6 cm. longum, ad lobos laterales 2.7 cm. latum, ungue concavo, dilute viridi, lobis lateralibus erectis, incurvis, oblique oblongis, apicem versus paulo angustatis, truncatis, margine postico subrectis, antice irregulariter marginatis, convexis, pallide viridibus, margine antico albescentibus, dilute plumbeo-striatis, c. 1 cm. longis, 0.5 cm. latis, lobo intermedio magno laxe undulato, apice decurvo, transverse subovali, dilute flavo-viridi,

striis ramosis punctorum plumbeorum ornato, c. 1.1 cm. longo, 1.9 cm. lato. Gynostemium brevissimum, album, subtus purpureo-punctatum, c. 0.3 cm. longum, auriculis incurvis, triangulis, obtusis. Anthera cucullata, antice plana, apice truncata, viridis, apice alba. Pes gynostemii cum ovario angulum obtusum faciens, rectus, apicem versus angustatus, truncatus, purpureo-punctatus, apice concavus et viridis, c. 8 cm. longus. Ovarium cranosulo-pilosum, pallide viride, c. 0.4 cm. longum, cum pedicello piloso pallide viridi-flavo c. 2 cm. longo angulum obtusum faciens.

Ternate: Auf dem Piek (J. J. S. 1900, n. 325 m. leb. Pfl.)

Von dem nächstverwandten *D. macrophyllum* A. Rich. ist diese Art durch kleinere Dimensionen, die Farbe, schmale Seitenlappen der Lippe und den am Grunde kaum mit den hinteren Rändern der Seitenlappen zusammenhängenden Callus verschieden.

Die Beschreibung wurde nach einer in Buitenzorg kultivierten Pflanze angefertigt.

Stems slender, erect, about 20 to 25 cm long, narrowly clavate with 4 to 6 nodes up to 2 cm in diameter at the thickest portion, diphyllous, when immature amply clothed with inflated, scarious sheaths which are imbricating and 2 to 8 cm long, uppermost node largest and grooved. Leaves oblong-elliptic, acute, 8 to 17.5 cm long, 4.2 to 6.1 cm wide. Floral bracts ovate-triangular, acute, much shorter than setigerous pedicels which are 2 cm long. Racemes short, about 10 cm long, laxly 6- to 7-flowered. Flowers 3.5 to 3.7 cm across. Lateral sepals triangular-ovate, acutely acuminate, carinate, externally setigerous, 20 to 22 mm long, about 10 mm wide, forming a very short spurlike mentum. Dorsal sepal similar to lateral sepals. Petals slightly curved, oblong-elliptic, acutely acuminate, glabrous, 15 to 18 mm long, about 6 mm wide. Labellum fleshy, 3-lobed, lobes subequal; lateral lobes erect, incurved, broadly cuneate, 15 to 16 mm long, 9 to 11 mm wide, apex truncate; middle lobe transversely oval, apiculate, 9 to 10 mm long, 16 to 17 mm wide; on the disc in front of the narrow claw a 3-lobed, erect, callus. Gynostemium very short, white, about 3 mm long.

Epiphyte; flowers slightly odorous; sepals baryta yellow; petals straw-yellow; front lobe of lip chalcedony yellow, lateral lobes pale pink with walnut brown and shade of purple, dotted at base on outside with deep corinthian red; callus ivory yellow; column white, dotted at base with liserian purple; pollinia olive yellow.

The species was originally known from Ternate. Its first Philippine representative, *H. N. Whitford No. 1083*, was collected in February 13, 1905, from Mount Mariveles, Bataan

Province, at an altitude of 900 meters. The other specimen was collected by H. Costenoble from Perak, Pampanga Province, Luzon, September 8, 1930 (*Phil. Nat. Herb. 3454 H. Costenoble*). Also coll. Loher, Rizal Province, September, 1909, *14592, 14593, 14702.*

Genus ERIA Lindley

ERIA ALICIAE Quisumbing sp. nov. Plate 5, figs. 1 to 12.

Habitu *E. longissimæ* Ames & Quis. similis. Caules validi caespitosi, simplices, basi teretes, superne leviter complanati, foliosi, 90 ad 155 cm longi, 8 ad 12 mm in diametro; internodia 2.5 ad 3.5 cm longa. Folia lineari-lanceolata, attenuata, acuta, 10 ad 19.4 cm longa, 1 ad 1.7 cm lata, glabra, in sicco subcoriacea, basi vaginantia. Inflorescentiae oppositifoliae saepissime, 3-florae; pedunculos usque ad racemum brevis; bracteae 3, conspicuae, glabrae, lanceolatae, acutae, 1.7 ad 2.6 cm longae, 2.5 ad 7 mm latae, in basi cordatae. Flores circiter 1 cm longi; pedicellus cum ovario glaber, 17 ad 18.5 mm longus. Sepala lateralia subfalcata, oblongo-ovata, obtusa, 16.5 ad 17 mm longa, 7 ad 8 mm lata, apici leviter carnosa, 7-nervia, mentum brevem obtusum formantia. Sepalum dorsale leviter cucullatum, oblongo-ovale, obtusum, 17 ad 18 mm longum, 7 ad 8 mm latum, 7-nervium. Petala leviter obliqua, oblongo-ovalia, obtusa, 13 ad 14 mm longa, 6 ad 7.5 mm lata, 5-nervia. Labellum sessile, in circuitu oblongo-ovatum simplex, apice rotundatum, circiter 1.3 cm longum; dencissime pubescens, prasertime in margine. Gynostemium 6 ad 6.5 mm longum.

An epiphyte with much the habit of *Eria longissima* Ames & Quis. Stems simple, stout, cæspitose, terete at the base, somewhat flattened above, drooping in habit, foliose, 90 to 155 cm long, 8 to 12 mm in diameter; internodes 2.5 to 3.5 cm long. Leaves linear-lanceolate, 10 to 19.4 cm long, 1 to 1.7 cm wide, gradually narrowed to the acute apex, glabrous, somewhat firm in living condition, subcoriaceous when dry, nervose, light green, base clasping, sheathed. Racemes very short compared with plant, opposite leaves, several-flowered; peduncles very short, not more than 5 mm long; bracts citron-yellow, conspicuous, glabrous, lanceolate, acute, 1.7 to 2.6 cm long, 2.5 to 7 mm broad. Flowers odorless, white, with a tinge of pink at base of the sepals and petals, about 1.5 cm long; pedicellate ovary glabrous, 17 to 18.5 mm long. Lateral sepals subfalcate, oblong-ovate, obtuse, 16.5 to 17 mm long, 7 to 8 mm wide, the very tip fleshy, 7-nerved,

forming a very short, obtuse mentum. Dorsal sepal slightly cucullate, oblong-oval, obtuse, 17 to 18 mm long, 7 to 8 mm wide, 7-nerved. Petals slightly oblique, oblong-oval, obtuse, 13 to 14 mm long, 6 to 7.5 mm broad, 5-nerved. Labellum sessile, whitish, cream with orange margins, oblong-ovate, ciliate, entire, about 1.3 cm long. Disc very densely and finely pubescent, without keels. Gynostemium 6 to 6.5 mm long.

LUZON, Benguet Subprovince, Baguio, altitude, 5,000 feet. Mrs. Colton's gardens, *Phil. Nat. Herb. 3455 Mrs. A. W. Day*, May, 1934. The living plants, which are being cultivated in the gardens of Mrs. Colton in Baguio, have been collected by Igorot peddlers from mountains in the vicinity of Baguio.

Eria Aliciæ is a near relative of *Eria longissima* Ames & Quis., from which it is readily distinguished by floral characters, notably by having broader sepals and petals and a simple lip.

Genus POAEPHYLLUM Ridley

POAEPHYLLUM GRANDIFLORUM Quisumbing sp. nov.

Caules complanati, circiter 65 cm alti. Folia linearia apice, obtuso minute bilobata, 5 ad 6.5 cm longa, 5 ad 7.5 mm lata. Racemi pauciflori, axillares, breves, 1.5 ad 2 cm longi. Flores albi. Sepala lateralia triangulari-lanceolata, acuminata, acuta, carinata, basi connata, mentum breve formantia, circiter 6.5 mm longa, 3 mm lata. Sepalum dorsale lineari-oblongum, acutum, circiter 5.5 mm longum, 2 mm latum, 1-nervium. Petala linearia, obtusa, circiter 5 mm longa, 1.5 mm lata, 1-nervia. Labellum circiter 6 mm longum, 4 mm latum, spathulatum, canaliculatum, apice subrotundatum, obtusum, linea incrassata carnosa in disco praeditum. Columna brevis, crassa; stelidia brevia, subulata, obtusa, erecta, circiter 0.05 mm longa. Pollinia 8.

Epiphyte, habit of *Agrostophyllum*. Stems slender, entirely concealed by leaf sheaths, flattened, leafy, about 65 cm high, about 5 mm wide, basal portion somewhat terete. Leaves distichous, linear, obtuse, minutely bilobed at apex, 5 to 6.5 cm long, 5 to 7.5 mm wide, about 1 cm distant; sheaths persistent. Racemes axillary, few-flowered, 1.5 to 2 cm long; peduncles very slender, rachis fractiflex. Flowers rather large for this genus, white; bracts minute, triangular-lanceolate, acute, 1.5 to 2 mm long. Lateral sepals triangular-lanceolate, acuminate, acute, carinate, base adnate to foot of column, about 6.5 mm long, 3 mm wide. Dorsal sepal linear-oblong, acute, about 5.5 mm long, 2 mm wide, 1-nerved. Petals linear, obtuse, about 5 mm long, 1.5 mm wide, 1-nerved. Labellum about 6 mm long,

4 mm wide at apex when expanded, spathulate, canaliculate, apex subrounded, obtuse, fleshy disc in center; anterior part of labellum concave, with erose margins. Column short, fleshy; stelidia very short, subulate, obtuse, erect, about 0.05 mm long. Pollinia 8, four appearing definitely smaller than remaining four.

PALAWAN, Mount Manalsal, *Bur. Sci. 77916 G. Edaño,* May 14, 1929, summit, altitude about 1,000 meters.

Vegetatively this plant appears to be a good match for *P. parviflorum* (J. J. Sm.) Ridl. (*Lectandra parviflora* J. J. Sm.). The presence of 8 pollinia and the central longitudinal thickening of the lip mark the plant as a representative of the genus *Poaephyllum*. But the single flower present is much larger than any in the genus, and the anterior part of the lip is concave with erose margins. Also, four of the pollinia appear definitely smaller than the other four.

ILLUSTRATIONS

[Plate 1 was prepared by Pedro Ramos; Plates 2 to 5 by V. V. Marasigan and R. C. Aguilar; Plates 6 and 7 were taken by the photographic section of the Bureau of Science.]

PLATE 1

FIG. 1. *Dendrobium ternatense* J. J. Sm., front view of flower, × 1.
2. *Dendrobium ternatense* J. J. Sm., side view of flower, × 1.
3. *Dendrobium macrophyllum* A. Rich., front view of flower, × 1.
4. *Dendrobium macrophyllum* A. Rich., side view of flower, × 1.
5. *Dendrobium Gonzalesii* Quis. sp. nov., front view of flower, × 1. (Type, *Phil. Nat. Herb. 3451 Eduardo Quisumbing.*)
6. *Dendrobium Gonzalesii* Quis. sp. nov., side view of flower, × 1. (Type, *Phil. Nat. Herb. 3451 Eduardo Quisumbing.*)
7. *Dendrobium Gonzalesii* Quis. sp. nov., front view of flower, × 1. (*Phil. Nat. Herb. 3452 Eduardo Quisumbing.*)
8. *Dendrobium Gonzalesii* Quis. sp. nov., side view of flower, × 1. (*Phil. Nat. Herb. 3452 Eduardo Quisumbing.*)

PLATE 2

Dendrobium Gonzalesii Quis. sp. nov., type. *1*, Habit, one-third natural size; *2*, dorsal sepal, × 1 (circa); *3*, petal, × 1 (circa); *4*, lateral sepal, × 1 (circa); *5*, column, spur, and labellum from above, × 1 (circa); *6*, front view of flower, × 1 (circa); *7*, side view of flower, × 1 (circa); *8*, front view of column, × 3 (circa); *9*, anther from above, × 7 (circa); *10*, anther from below, × 7 (circa); *11*, pollinia, × 7 (circa). *Phil. Nat. Herb. 3452 Eduardo Quisumbing: 12*, front view of flower, × 1 (circa); *13*, side view of flower, × 1 (circa); *14*, column, spur, and labellum from above, × 1 (circa).

PLATE 3

Dendrobium macrophyllum A. Rich. *1*, Dorsal sepal, × 1; *2*, lateral sepal, × 1; *3*, petal, × 1; *4*, bract, × 1; *5*, front view of column, × 3; *6*, labellum from above (natural position), × 1; *7*, side view of labellum (natural position), × 1; *8*, labellum from above (stretched out), × 1; *9*, anther from above, × 8; *10*, anther from below, × 8; *11*, pollinia, × 8.

Dendrobium ternatense J. J. Sm. *12*, Dorsal sepal, × 1; *13*, lateral sepal, × 1; *14*, petal, × 1; *15*, bract, × 1; *16*, labellum and column from above (natural position), × 1; *17*, side view of ovary, and labellum (natural position), × 1; *18*, labellum from above (stretched out), × 1; *19*, anther from above, × 8; *20*, anther from below, × 8; *21*, pollinia, × 8.

PLATE 4

Dendrobium quadrisulcatum J. J. Sm. *1*, Habit, one-third natural size; *2*, flower, showing labellum, column, sepals, and petals from above (natural position), × 1; *3*, side view of flower showing pedicel, ovary, spur, column, sepals, petals, and labellum (natural position), × 1; *4*, dorsal sepal, × 2; *5*, petal, × 2; *6*, lateral sepal, × 2; *7*, labellum from above (natural position), × 1; *8*, labellum from above (stretched out), × 1; *9*, front view of column, × 2; *10*, anther from above, × 4; *11* anther from below, × 4; *12*, pollinia, × 4.

PLATE 5

Eria Aliciae Quis. sp. nov. *1*, Upper portion of stem, one-fourth natural size; *2*, bract, × 1; *3*, dorsal sepal, × 1; *4*, lateral sepal, × 1; *5*, petal, × 1; *6*, front view of column, and labellum (natural position), × 2; *7*, side view of ovary, column, and labellum (natural position), × 2; *8*, front view of column, × 2; *9*, labellum from above (stretched out), × 2; *10*, anther from above, × 5.5; *11*, anther from below, × 5.5; *12*, pollinia, × 5.5.

PLATE 6

FIG. 1. *Dendrobium ternatense* J. J. Sm. Habit, very much reduced.
2. *Dendrobium ternatense* J. J. Sm. Top of plant with flowers, much reduced.

PLATE 7

FIG. 1. *Dendrobium macrophyllum* A. Rich. Habit; very much reduced.
2. *Dendrobium macrophyllum* A. Rich. Flowers, reduced.

PLATE 1.

PLATE 2.

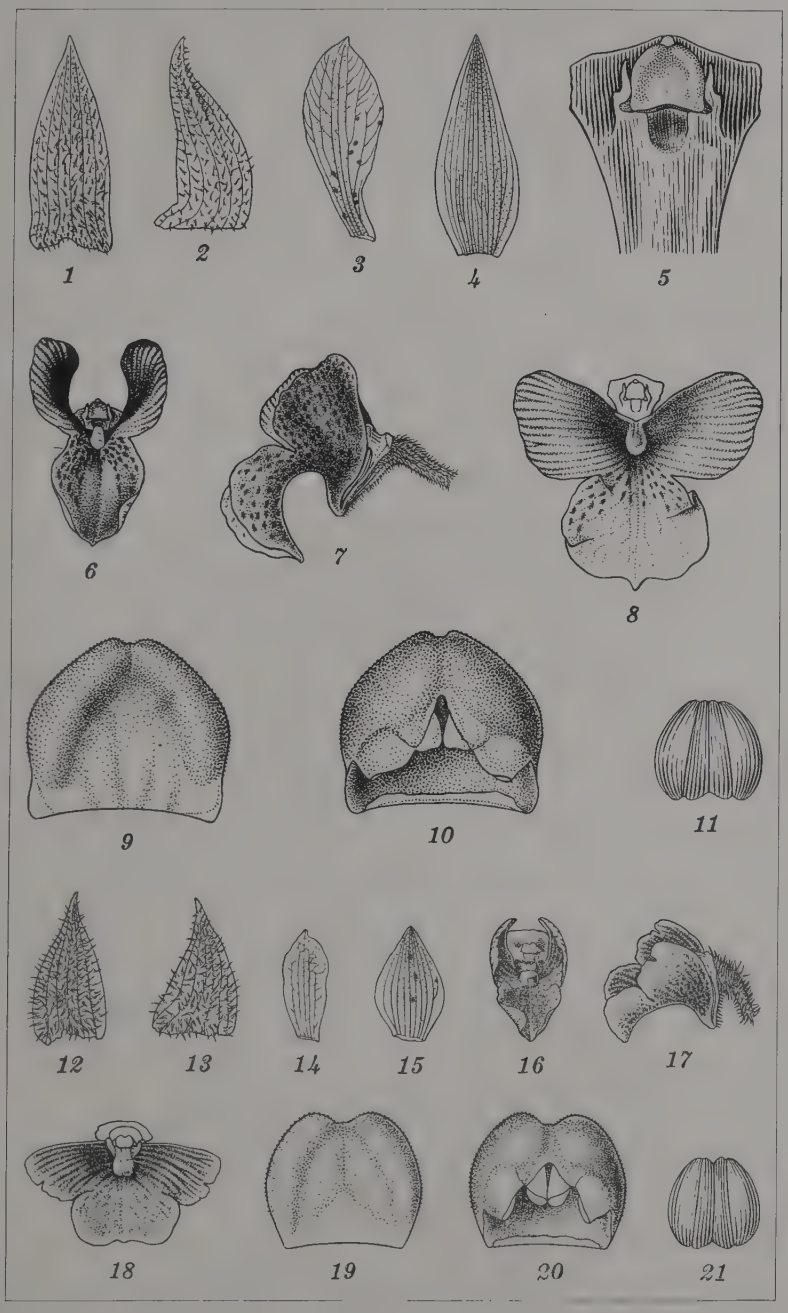

PLATE 3.

PLATE 4.

PLATE 5.

PLATE 6.

PLATE 7.

CHEMICAL FRACTIONATION OF LEPROTIC NODULES, I [1]

ISOLATION OF THE LIPID FRACTIONS

By Ernesto M. Paras

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INTRODUCTION

Undoubtedly one of the major obstacles to progress in the study of the complex problems of human leprosy is the apparent noncultivability of its causative agent. However, the skin lesion known as the leprotic nodule is fortunately of such a unique nature as to constitute an ideal source of material for biologic and chemical study. This tissue is usually heavily laden with *Mycobacterium lepræ*. The nodules can be easily removed without much discomfort to the patient, and most lepers, in this Colony at least, have no objection to and even welcome the excision of some of their larger nodules.

A saline suspension of the ground leprotic nodules has been used for studying certain biological aspects of leprosy. Teague(10) appears to be the first to employ a leprous extract for studying skin reaction in lepers, but he apparently failed to take cognizance of its significance. Mitsuda(7) appeared to be the first to call attention to the biological importance of the test. He found significantly different responses in nodular from those in maculo-anæsthetic cases of leprosy, which he interpreted as expressing the degree of the disease. This observation was extended by his pupil, Hayashi,(5) by Mariani,(6) Bargehr,(2) Chiyuto,(3) Fernandez,(4) and Schujman,(9) to mention only some of the later workers.

The biological reactions obtained from the use of this preparation have been produced not only by the presumably living but also by the dead bacilli. Also, the degree or intensity of reaction apparently depends on the quantity of bacilli in the preparation. These findings would suggest that some constituent, single or complex, derived either from the bacilli directly or from their

[1] Published with the approval of the Director of Health.

metabolites, is responsible for the reaction. In the leprolin preparations as heretofore employed by investigators, obviously a very complex mixture is involved, in which the active substance is only one of many constituents. It is evident, then, that the present leprolin test is unsatisfactory from the quantitative viewpoint. It was probably the realization of this fact that led Montanes(8) to attempt to obtain purely bacillary material from leprotic nodules. To accomplish this he digested the heavily infected leprotic tissue with strong alkali, and then centrifuged it so as to throw off the leprosy organisms. He claimed that with a suspension of the separated organisms in physiological salt solution he obtained skin reactions comparable to those from ordinary "leprolin." While this may be considered a refinement of the leprolin test and a step toward the elucidation of the phenomenon of leprolin reaction, the method still leaves something to be desired. It should be considered that the leprosy organisms may vary in age, strain(?), virulence, acid-fastness, and in other factors that may influence the reactions. Again, the leprosy bacillus is presumably of complex composition, and different constituents of a given organism have each their own specific biological properties. In view of the above considerations, a preparation containing only the active principle, free as much as possible from contaminating substances, would seem highly desirable and should be able to elicit a fairly constant skin reaction under certain conditions.

Toward this end, and with the further aim of finding materials that may apply to the study of problems related to the immunology of leprosy the present work was undertaken.

In the present work it was considered necessary to undertake first the isolation of the lipid fractions, firstly because the removal of this constituent, especially from acid-fast bacilli, has been found to facilitate the extraction of the nonlipid constituents, and secondly because of the biological importance ascribed to the lipids.

EXPERIMENTAL PROCEDURE

The nodules, which were freshly removed, were immediately transferred to a sterile container, the blood washed out with double-distilled water, and the adhering fibrous tissue trimmed off; the material thus cleaned was weighed, cut into very small pieces first with a dissecting knife then with scissors, and finally dried in a vacuum oven at a temperature of not more than 40° C.

The weight of the dissected material before drying was 105.2 grams; this was reduced to only 20.4 grams. The loss of 84.8 grams, or 80.6 per cent, represents the water content of the nodules. The dried material was then ground in a thoroughly cleaned meat grinder. The lipid fractions were isolated in the form of a phosphatide, an acetone-soluble fat, and a wax, according to the method used by Anderson in his chemical study of the tubercle bacillus.(1) The extractions were made at room temperature, so as to conserve as much as possible the constituents in the form in which they existed in the living cells.

Isolation of phosphatides.—The ground tissue was placed in a 500 cc bottle containing 200 cc of a mixture of equal volume of purified alcohol and ether. The whole mixture was allowed to stand at room temperature for four weeks, with occasional shaking of the container each day. At the end of the period the solution had changed from colorless to pale yellow. After the solvent was filtered off in a Buchner funnel, the tissue residue turned out as a pale-brown, hard mass. This residue was immediately mixed with about 100 cc of chemically pure chloroform in a 150 cc Pyrex Erlenmeyer flask and allowed to stand at room temperature, to be worked out later for the extraction of wax as described below. The alcohol-ether filtrate containing the extracted material contained an insoluble residue which settled down to the bottom of the container on standing. This residue was separated off by centrifuging and added to the residue under treatment with chloroform.

The ether in the alcohol-ether filtrate supposedly containing the phosphatides was removed by distillation under reduced pressure. The remaining undistilled portion was optically clear but of a much deeper color, nearly red. It was shaken with ether repeatedly in a separatory funnel until the lipids were extracted. The ethereal extract was then dried with anhydrous sodium sulphate overnight, filtered, and finally concentrated in the vacuum oven at a temperature not above 40° C. To the concentrate an equal volume of pure acetone was added and then left to stand for 24 hours. A light-orange precipitate of phosphatides was obtained, which darkens immediately to a deep brown when separated from its mother liquor. This precipitate was washed once with acetone, and the washings and the mother liquor, combined and treated again with acetone, allowed to stand overnight in the ice box. A further precipitate of phosphatides was obtained and the mother liquor saved for the isolation of

acetone-soluble fat. The two precipitates just described were redissolved in sufficient amounts of ether, which were combined and finally added to an equal volume of ice-cold acetone. A very pale yellow, granular precipitate of phosphatides was obtained, which on exposure to air lost its crystalline appearance, with its color deepened to reddish brown. The odor was strong and fishy, and appeared somewhat hygroscopic. The total weight of the phosphatides obtained was 650 mgs, or about 3.2 per cent of the dry weight of the ground tissue. The amount of material was too small to permit further purification for chemcial analysis.

Isolation of the acetone-soluble fat.—After the precipitation of the phosphatide just described, the acetone mother liquors containing the dissolved acetone-soluble fats were united, and the solvent was distilled off with the aid of a vacuum pump at a temperature not above 40° C. The residue was then completely dried in a current of air from an electric fan and finally in a vacuum desiccator over sulphuric acid. The product obtained weighed 1.3 grams, or about 6.4 per cent of the dry weight of the original material. It was of oily consistency and of deep wine color. After a few days standing at room temperature the mass separated into an oily and a solid portion, a small oily red portion being in the upper layer and a larger yellow solid substance occupying mainly the lower portions. The odor was characteristic but not as offensive as that of the phosphatides.

Extraction of wax with chloroform.—The tissue, which was macerated with chloroform after having been treated with the alcohol-ether mixture, was separated from its chloroform solvent by filtration in a Buchner funnel. The remaining unextracted tissue residue was immediately mixed with about 200 cc of distilled water containing 0.5 per cent phenol, and allowed to stand at room temperature to be worked out later for the isolation of proteins.[2] The filtrate comprising the chloroform extract was subjected to vacuum distillation at a temperature not above 40° C. until all the chloroform had been removed. The undistilled portion, consisting of the extracted wax, had the consistency of a syrupy mass, homogeneous in appearance, deep red, and weighing 0.3 grams, or about 1.5 per cent of the dry weight of the original material. The odor was characteristic.

[2] The work on the isolation of proteins will form the second part of this paper which will appear at a later date.

Solubility.—The solubility of each of the fractions isolated was tried on vehicles which are commonly employed for parenteral injections. The phosphatide fraction was found to be insoluble both in water and in physiological salt solution, but it gave a fine suspension with these vehicles. The acetone-soluble fat and the wax were both very immiscible with water and with physiological salt solution, but both were quite soluble in an oily solvent, like olive oil.

Skin test.—The isolated lipid fractions described in this paper were subjected to a preliminary skin test [3] on a few leprosy cases, and according to the results so far obtained the wax was found to possess the property of eliciting a definite skin reaction simulating, but not as intense or as distinctive as, that from an ordinary leprolin preparation, with respect to the neural and the cutaneous types of leprosy. The acetone-soluble fat and the phosphatide, at the concentration employed, gave practically negative results.

SUMMARY

Leprotic nodules removed from living cases were subjected to a systematic fractionation into the major lipid components, such as phosphatide, acetone-soluble fat, and wax, as part of the work being undertaken on nodular tissue with a view (*a*) to isolate the principal constituent of leprotic tissue that is responsible for the leprolin reaction, and (*b*) to search for materials that may find application in the study of problems related to the immunochemistry of leprosy.

Preliminary skin tests on a few cases of leprosy showed that of the lipid fractions isolated, only the wax appears to possess a significant biological property.

ACKNOWLEDGMENT

The author desires to express his thanks to Dr. C. B. Lara, chief physician of the medical section of the Culion Leper Colony, for his suggestions in connection with the preparation of this paper.

[3] The test was performed by Dr. M. Lagrosa, of the medical section of the Culion Leper Colony, to whom the author expresses his thanks. The method consisted in injecting intradermally in the forearm 0.1 cc of a solution or suspension in physiological salt solution or purified olive oil containing 1 mg of the substance isolated, using as controls the solvents used and a leprolin preparation. The reactions were observed after 48 hours and weekly thereafter for one month. The tests will be continued on a larger number of cases and the results reported in a separate paper.

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DIATOMS FROM A PEATY BOG IN LIANCHIHO RIVER VALLEY, EASTERN SIBERIA

By B. W. Skvortzow

Of Harbin, Manchoukuo

THREE PLATES

Several years ago I received through Mr. I. P. Popov, of the Botanical Laboratory of Far Eastern University, Vladivostok, a sample of diatoms collected by him during a botanical survey of Primorsk Province in a *Carex-Sphagnum* peaty bog in Lianchiho River valley, about 40 kilometers west of Vladivostok, not far from the seashore.

The diatoms collected were essentially northern in character, and presented great similarity to those of northern Manchoukuo, Nippon, and Korea. The presence in Lianchiho valley of *Eunotia monodon* var. *koreana* and *Pinnularia nobilis* var. *parallela* recently reported as fossils from Korea is interesting. Some of the new species, as *Achnanthes fragilis* and *Caloneis sphagnicola*, found in mountain bogs of northern Manchuria, were recognized in the present collection. *Pinnularia gentilis* var. *sibirica*, reported from Lake Kenon of Transbaikalia, was also found in Lianchiho valley. Several Manchurian diatoms, as *Pinnularia streptoraphe* var. *interrupta*, *Pinnularia distinguenda* var. *asiatica*, *Cymbella turgida* var. *muscosa*, and *Nitzschia capitellata* var. *montana*, were also represented in the sample. Among 94 different forms of diatoms listed in the present paper, 20 are proposed as new to science. They are as follows:

Eunotia asiatica sp. nov.
Eunotia asiatica var. *interrupta* var. nov.
Eunotia monodon Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
Navicula muscosa sp. nov.
Navicula sohrensis var. *parallela* var. nov.
Navicula cincta fo. *sphagnicola* fo. nov.
Pinnularia subcapitata fo. *tenua* fo. nov.
Pinnularia divergentissima var. *lata* var. nov.
Pinnularia karelica var. *subcapitata* var. nov.
Pinnularia subsolaris var. *asiatica* var. nov.
Pinnularia gibba fo. *polymorpha* fo. nov.
Pinnularia viridis var. *orientalis* var. nov.
Pinnularia nobilis var. *distincta* var. nov.

Pinnularia distinguenda var. *sphagnicola* var. nov.
Pinnularia isostauron var. *orientalis* var. nov.
Pinnularia sphagnicola sp. nov.
Cymbella amphioxys var. *asiatica* var. nov.
Cymbella perpusilla fo. *elongata* fo. nov.
Cymbella gracilis fo. *sphagnicola* fo. nov.
Gomphonema longiceps var. *montana* fo. *minuta* fo. nov.

Both Latin and English diagnoses are given for new forms. The drawings were made by the author with E. Leitz Apochromat 2 mm and Compens Okular No. 4.

TABELLARIA FENESTRATA (Lynb.) Kützing.

Tabellaria fenestrata (Lynb.) Kützing, Fr. Hustedt, Bacillar. (1930) 122, 123, fig. 99.

Infrequent. Reported from bogs and peaty moors.

EUNOTIA PAPILIO Ehr. Plate 3, fig. 5.

Eunotia papilio Ehr., A. Schmidt, Atlas Diatom. (1911) pl. 273, fig. 34.

Valve arcuate, with slightly concave ventral and broad arcuate dorsal margin. Ends rostrate-capitate, obtuse. End nodules distinct, curved. Striæ radiate, 9 in 0.01 mm. Between striæ on the dorsal margin shorter marginal striæ. Length, 0.06 mm; breadth 0.02. Infrequent.

EUNOTIA PRAERUPTA Ehr. Plate 3, figs. 3, 4, 10, and 18.

Eunotia praerupta Ehr., A. Schmidt, Atlas Diatom. (1911) pl. 273, figs. 12–14, 25.

Valve arcuate, with slightly concave ventral margin and broad subcapitate ends. Two distinct forms have been observed. (1) Valve with robust striæ. Length, 0.045 to 0.074 mm; breadth, 0.0135 to 0.017. Striæ 4 to 7 in 0.01 mm (Plate 3, figs. 3 and 4). (2) Valve with coarser striæ, about 12 in 0.01 mm. Length, 0.054 to 0.093 mm; breadth, 0.015 to 0.017 (Plate 3, figs. 10 and 18). Very common.

EUNOTIA PRAERUPTA Ehr. fo. CURTA Grunow. Plate 1, fig. 29.

Eunotia praerupta Ehr. fo. *curta* Grunow, A. Schmidt, Atlas Diatom. (1911) pl. 273, figs. 10, 11.

Smaller than the type. Length, 0.025 mm; breadth, 0.0085. Striæ 12 in 0.01 mm. Not common.

EUNOTIA PRAERUPTA Ehr. var. BIDENS Grunow. Plate 3, figs. 6 and 21.

Eunotia praerupta Ehr. var. *bidens* Grunow, A. Schmidt, Atlas Diatom. (1911) pl. 273, figs. 26–28, 32, 33.

Differs from the type in its biarcuate dorsal margin. Length, 0.032 to 0.068; breadth, 0.0051 to 0.0136. Striæ 7 to 15 in 0.01 mm. Very common.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grunow. Plate 3, fig. 15.

Eunotia praerupta Ehr. var. *inflata* Grun., A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 12, 23.

Valve arcuate, with almost straight ventral and moderately arcuate dorsal margin. Length, 0.045 to 0.051 mm; breadth, 0.0157 to 0.017. Striæ 7 to 10 in 0.01 mm. Very common.

EUNOTIA PRAERUPTA Ehr. var. INFLATA Grun. fo. CURTA Grunow. Plate 3, fig. 11.

Eunotia praerupta Ehr. var. *inflata* Grun. fo. *curta* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, fig. 18.

Valve length, 0.04 mm; breadth, 0.017. Striæ 7 to 8 in 0.01 mm. Common.

EUNOTIA PRAERUPTA Ehr. var. LATICEPS Grunow. Plate 2, fig. 13.

Eunotia praerupta Ehr. var. *laticeps* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 273, figs. 15–17.

Valve length, 0.0238 mm; breadth, 0.006. Striæ 12 in 0.01 mm. Infrequent.

EUNOTIA BIGIBBA Kütz. var. PUMILA Grunow. Plate 1, fig. 15; Plate 3, figs. 14, 19, and 22.

Eunotia bigibba Kütz. var. *pumila* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 274, figs. 58–64.

Valve small, robust, arcuate, ventral margin concave only in the middle part, dorsal biarcuate with produced broad-obtuse ends. Striæ slightly radiate, 12 to 15 in 0.01 mm. Length, 0.012 to 0.02 mm; breadth, 0.005. Common.

EUNOTIA ARCUS Ehr. Plate 2, figs. 18? and 20.

Eunotia arcus Ehr., A. SCHMIDT, Atlas Diatom. (1911) pl. 274, figs. 33–43, 55.

Valve arcuate, with concave ventral and arcuate dorsal margin. Length, 0.025 to 0.027 mm; breadth, 0.0034 to 0.0042. Striæ 15 in 0.01 mm. Infrequent.

EUNOTIA ARCUS Ehr. var. BIDENS Grunow. Plate 1, fig. 14; Plate 2, figs. 16 and 17.

Eunotia arcus Ehr. var. *bidens* Grunow, A. SCHMIDT, Atlas Diatom. (1911) pl. 274, fig. 46.

Valve arcuate, biundulate, with capitate, abrupt, ends. Length, 0.0187 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Common.

EUNOTIA TENELLA (Grun.) Hustedt. Plate 2, figs. 10 and 14.

Eunotia tenella (Grun.), FR. HUSTEDT, Bacillar. (1930) 175, fig. 220.

Valve moderately arcuate, with slightly concave ventral and arcuate dorsal sides. Ends subcapitate. Length, 0.015 to 0.02

mm; breadth, 0.0025. Striæ 15 in 0.01 mm. Somewhat narrower than the type. Common. Reported from moss bogs.

EUNOTIA TRIDENTULA Ehr. var. PERMINUTA Grunow. Plate 2, fig. 11.

Eunotia tridentula Ehr. var. *perminuta* Grunow, FR. HUSTEDT, Bacillar. (1930) 180, fig. 233.

Valve minute, with ventral margin biundulate, dorsal triundulate. Ends obtuse and abrupt. Length, 0.012 mm; breadth, 0.0034. Striæ 15 in 0.01 mm. Infrequent. Reported from moss bog of Gaolinitze, northern Manchuria.

EUNOTIA PECTINALIS (Kütz.) Rabh.

Eunotia pectinalis (Kütz.) Rabh., FR. HUSTEDT, Bacillar. (1930) 180, 181, fig. 237.

Valve almost straight, with arcuate dorsal margin and subrostrate ends. Length, 0.068 mm; breadth, 0.006. Striæ 11 to 12 in 0.01 mm. Rare.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. MINOR (Kütz.) Rabh. fo. IMPRESSA (Ehr.). Plate 2, fig. 19.

Eunotia pectinalis (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.), FR. HUSTEDT, Bacillar. (1930) 182, fig. 239.

Valve with almost straight ventral and biarcuate dorsal margin. Length, 0.019 mm; breadth, 0.0034. Striæ 15 to 18 in 0.01 mm. Rare.

EUNOTIA KOCHELIENSIS O. Müll. Plate 3, figs. 9 and 12.

Eunotia kocheliensis O. Müll., FR. HUSTEDT, Bacillar. (1930) 182, fig. 244.

Valve semielliptic, short, with broad-rounded ends. Length, 0.0076 to 0.01 mm; breadth, 0.0045 to 0.0051. Striæ 11 to 12 in 0.01 mm. Somewhat narrower than the type. Infrequent. Reported from Europe.

EUNOTIA VENERIS (Kütz.) O. Müll. Plate 1, fig. 31.

Eunotia veneris (Kütz.) O. Müll., A. SCHMIDT, Atlas Diatom. (1913) pl. 294, figs. 13–15.

Valve semielliptic, with straight ventral and arcuate dorsal margins, produced to the rounded ends. Length, 0.014 to 0.032 mm; breadth, 0.0034 to 0.004. Striæ 12 in 0.01 mm. Common.

EUNOTIA ASIATICA sp. nov. Plate 1, figs. 17, 18, and 33.

Valvis modice inflexis, ventre constrictis, dorso concavis cum polis obtusis rotundatis, nodulis terminalis distinctis. Striis transversis, 15 in 0.01 mm. Longis valvis 0.0085 ad 0.017 mm; latis valvis 0.002 ad 0.0029. Habit. in aquis stagnalis prope

Lianchiho rivum. Primorsk Prov., Siberia orientalis. Legit I. P. Popov.

Valve lunate, ventral margin concave, dorsal arcuate, with broad-rounded ends. End nodules small. Striæ fine, about 15 in 0.01 mm. Length, 0.0085 to 0.017 mm; breadth, 0.002 to 0.0029. Common. A species akin to *Eunotia lunaris* (Ehr.) Grun.

EUNOTIA ASIATICA sp. nov. var. INTERRUPTA var. nov. Plate 1, fig. 35.

Differt a typo medium valvis interruptis et parallelis. Longis valvis 0.0155 mm; latis valvis 0.0021. Striis 15 in 0.01 mm. Cum forae typicum.

Differs from the type in the straight middle part with parallel margins. Infrequent.

EUNOTIA ELEGANS Oestrup. Plate 2, fig. 27.

Eunotia elegans Oestrup, Fr. Hustedt, Bacillar. (1930) 183, fig. 248.

Valve distinctly lunate, with capitate ends. Length, 0.039 mm; breadth, 0.0025. Striæ 20 in 0.01 mm. Infrequent. Reported from northern Europe.

EUNOTIA ALPINA (Naeg.) Hust.

Eunotia alpina (Naeg.) Fr. Hustedt, Bacillar. (1930) 185, fig. 252.

Valve slightly curved, with moderately reflexed ends. Length, 0.051 mm; breadth, 0.028. Striæ 15 in 0.01 mm. Common.

EUNOTIA GRACILIS (Ehr.) Rabh. Plate 1, fig. 8.

Eunotia gracilis (Ehr.) Rabh., Fr. Hustedt, Bacillar. (1930) 185, fig. 253.

Valve lunate, very narrow, with slightly capitate ends. Length, 0.093 to 0.102 mm; breadth, 0.005 to 0.0055. Striæ 10 to 12 in 0.01 mm. Common.

EUNOTIA MONODON Ehr. var. KOREANA Skvortzow. Plate 3, fig. 2.

Eunotia monodon Ehr. var. *koreana* Skvortzow, Neogene diatoms from environs of Gensan, Korea (1936) pl. 1, figs. 13, 14, 19?, 20, 30, 33.

Valve slightly curvate, moderately arcuate at the dorsal margin. Ends recurved, broad-rounded. Length, 0.054 mm; breadth, 0.0068. Striæ 11 to 12 in 0.01 mm. Common. Reported as a fossil from Korea.

EUNOTIA MONODON Ehr. var. KOREANA Skvortzow fo. BIDENS fo. nov. Plate 1, fig. 30; Plate 2, fig. 23; Plate 3, fig. 13.

Differt a var. koreana marginem dorsali biarcuatis. Longis valvis 0.034 ad 0.051 mm; latis valvis 0.0068 ad 0.0085. Striis

9 ad 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulum, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from var. *koreana* in biundulate dorsal margin. Infrequent.

ACHNANTHES MINUTISSIMA Kützing.

Achnanthes minutissima Kützing, Fr. Hustedt, Bacillar. (1930) 198, fig. 274.

Valve narrow lanceolate with obtuse ends. Length, 0.012 mm; breadth, 0.0025. Infrequent.

ACHNANTHES LINEARIS W. Smith. Plate 1, fig. 36.

Achnanthes linearis W. Smith, Fr. Hustedt, Bacillar. (1930) 198, fig. 276.

Valve elliptic-lanceolate with broad ends. Length, 0.01 mm; breadth, 0.0028. Striæ indistinct. Not common.

ACHNANTHES LINEARIS W. Smith var. PUSILLA Grun. Plate 1, fig. 11.

Achnanthes linearis W. Smith var. *pusilla* Grun., Fr. Hustedt, Bacillar. (1930) 198, fig. 277.

Valve linear with broad ends. Length, 0.0136 mm; breadth. 0.0028. Striæ 18 in 0.01 mm. Infrequent.

ACHNANTHES FRAGILIS Skvortzow. Plate 1, figs. 32 and 34.

Achnanthes fragilis Skvortzow, Diatoms flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 26.

Valve elliptic, with obtuse ends. Length, 0.005 to 0.0068 mm; breadth, 0.0017 to 0.0025. Striæ indistinct. Common. Reported from Kaolingtze, northern Manchuria.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni.

Frustulia rhomboides (Ehr.) de Toni, Fr. Hustedt, Bacillar. (1930) 220, fig. 324.

Valve rhombic-lanceolate, tapering from the middle to subacute ends. Length, 0.093 mm; breadth, 0.018. Infrequent. Common in mountain bogs.

FRUSTULIA RHOMBOIDES (Ehr.) de Toni var. SAXONICA (Rabh.) de Toni.

Frustulia rhomboides (Ehr.) de Toni var. *saxonica* (Rabh.) de Toni, Fr. Hustedt, Bacillar. (1930) 221, fig. 325.

Smaller than the type. Valve elliptic-lanceolate. Length, 0.049 to 0.068 mm; breadth, 0.0085 to 0.015. Very common.

FRUSTULIA RHOMBOIDES Ehr. var. LINEOLATA Ehr. Plate 2, fig. 22.

Frustulia rhomboides Ehr. var. *lineolata* Ehrenberg, Microgeologie (1856) 16; pl. 1, fig. 3.

Valve lanceolate, with five coarse longitudinal furrows on each side. Length, 0.054 mm; breadth, 0.012. Infrequent.

CALONEIS SILICULA (Ehr.) Cleve var. ALPINA Cleve. Plate 3, fig. 20.

Caloneis silicula (Ehr.) Cleve var. *alpina* Cleve, Fr. Hustedt, Bacillar. (1930) 238, fig. 366.

Valve linear, triundulate, with obtuse-rounded ends. Length, 0.022 mm; breadth, 0.0056. Very rare. Reported from mountain districts.

CALONEIS SPHAGNICOLA Skvortzow. Plate 3, fig. 24.

Caloneis sphagnicola Skvortzow, Diatoms flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 27.

Valve linear-lanceolate, with slightly gibbous middle part and protracted ends. Length, 0.035 mm; breadth, 0.005. Striæ 22 in 0.01 mm. Rare. Reported from Kaolingtze, northern Manchuria.

NEIDIUM BISULCATUM (Lagerst.) Cleve.

Neidium bisulcatum (Lagerst.) Cleve, Fr. Hustedt, Bacillar. (1930) 242, fig. 374.

Infrequent. Length, 0.04 mm; breadth, 0.0068. Striæ 30 in 0.01 mm. Not common.

NEIDIUM BISULCATUM (Lagerst.) Cleve fo. UNDULATA O. Müll. Plate 1, fig. 1.

Neidium bisulcatum (Lagerst.) Cleve fo. *undulata* O. Müll., Fr. Hustedt, Bacillar. (1930) 242, fig. 375.

Valve slightly gibbous in the middle part. Length, 0.085 mm; breadth, 0.01. Striæ 21 to 25 in 0.01 mm. Larger than the type. Common.

NEIDIUM IRIDIS (Ehr.) Cleve var. AMPLIATA (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve var. *ampliata* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 245, fig. 381.

Valve elliptic-lanceolate, with obtuse ends. Length, 0.093 to 0.098 mm; breadth, 0.03 to 0.032. Striæ 20 in 0.01 mm. Infrequent.

DIPLONEIS OVALIS (Hilse) Cleve.

Diploneis ovalis (Hilse) Cleve, Fr. Hustedt, Bacillar. (1930) 249, fig. 390.

Valve elliptic, with broad ends. Length, 0.03 mm; breadth, 0.013. Striæ 14 in 0.01 mm. Rare.

DIPLONEIS PUELLA (Schum.) Cleve.

Diploneis puella (Schum.) Cleve, Fr. Hustedt, Bacillar. (1930) 250, fig. 394.

Valve elliptic. Striæ indistinctly punctate. Length, 0.027 to 0.028 mm; breadth, 0.0135 to 0.014. Striæ 12 to 14 in 0.01 mm. Rare.

STAURONEIS ANCEPS Ehr.

Stauroneis anceps Ehr., Fr. Hustedt, Bacillar. (1930) 256, fig. 405.

Infrequent. Length, 0.074 mm; breadth, 0.0136. Striæ 18 in 0.01 mm.

STAURONEIS ANCEPS Ehr. fo. LINEARIS (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *linearis* (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 256, fig. 407.

Valve linear-elliptic, with parallel margins and attenuate capitate ends. Length, 0.051 mm; breadth, 0.09. Infrequent.

STAURONEIS PHOENICENTERON Ehr.

Stauroneis phoenicenteron Ehr., Fr. Hustedt, Bacillar. (1930) 255, fig. 404.

Valve lanceolate, tapering from the middle to the subacute ends. Length, 0.17 mm; breadth 0.035. Infrequent.

NAVICULA PLACENTA Ehr.

Navicula placenta Ehr., Fr. Hustedt, Bacillar. (1930) 290, fig. 492.

Valve elliptic, with small rostrate ends. Length, 0.039 mm; breadth, 0.015. Striæ 25 in 0.01 mm. Infrequent. Reported from Kaolingtze, northern Manchuria. Common in alpine districts.

NAVICULA MUSCOSA sp. nov. Plate 1, fig. 20.

Valvis lineari-lanceolatis marginem parallelis attenuatis cum polis rostratis obtusis. Area axillaris et centralis anguste linearis. Striis delicatissimis longitudinalis indistinctis. Longis valvis 0.018 mm; latis valvis 0.005. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, with rostrate ends. Median line filiform. Axial and central area very narrow linear. Striæ forming indistinct longitudinal lines. Length, 0.018 mm; breadth, 0.005. Rare. Belongs to Sect. Naviculæ minusculæ Cleve.

NAVICULA SOHRENSIS Krasske var. PARALLELA var. nov. Plate 3, fig. 16.

Differt a typo valvis linearis, area axillaris lanceolata, ad porum centralem transverse dilatata. Longis valvis 0.017 mm; latis valvis 0.0027. Striis 15 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, with slightly attenuate ends. Axial area very narrow, central area a broad rectangular fascia. Length, 0.017 mm; breadth, 0.0027. Striæ 15 in 0.01 mm. Differs from the type in its linear valves with interrupted striæ in the middle part. Rare.

NAVICULA CINCTA (Ehr.) Kütz. fo. SPHAGNICOLA fo. nov. Plate 2, fig. 29.

Valvis formae typicae consimilis, minute autem striis robustris. Longis valvis 0.042 mm; latis valvis 0.0065. Striis 10 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve narrow linear-lanceolate, with attenuate-rounded ends. Length, 0.042 mm; breadth, 0.0065. Striæ 10 in 0.01 mm. More robust than the type and not longer and shorter in the middle. Infrequent.

NAVICULA IGNOTA Krasske. Plate 2, fig. 25.

Navicula ignota KRASSKE, Beiträge zur Kenntniss der Diatomeenflora der Alpen (1932) 111, fig. 19.

Valve linear-lanceolate, triundulate. Length, 0.019 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Smaller than the type. Rare. Reported from northern Manchuria, and from Shanghai and Hangchow, China.

Genus PINNULARIA Ehrenberg

PINNULARIÆ CAPITATÆ

PINNULARIA APPENDICULATA (Agardh) Cleve. Plate 2, fig. 8.

Pinnularia appendiculata (Agardh) Cleve, FR. HUSTEDT, Bacillar. (1930) 317, fig. 570*a*.

Valve linear-lanceolate, with slightly attenuate and subcapitate ends. Length, 0.035 mm; breadth, 0.005. Costæ 12 to 13 in 0.01 mm. Common. Differs from the type in its more robust striæ.

PINNULARIA SUBCAPITATA Greg. fo. TENUA fo. nov. Plate 1, fig. 26.

Differt a typo valvis angustior. Longis valvis 0.024 mm; latis valvis 0.0034. Costis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in its narrower valves. Infrequent.

PINNULARIA MESOLEPTA (Ehr.) Smith fo. ANGUSTA Cleve. Plate 1, fig. 27.

Pinnularia mesolepta (Ehr.) W. Smith fo. *angusta* Cleve, FR. HUSTEDT, Bacillar. (1930).

Length, 0.04 to 0.047 mm; breadth, 0.005 to 0.0068. Costæ 10 to 14 in 0.01 mm. Common.

PINNULARIA BRAUNII (Grun.) Cleve.

Pinnularia Braunii (Grun.) Cleve, Fr. Hustedt, Bacillar. (1930) 319, fig. 517.

Narrower than the type. Length, 0.042 mm; breadth, 0.0068. Costæ 12 in 0.01 mm. Rare.

PINNULARIÆ DIVERGENTES

PINNULARIA DIVERGENTISSIMA (Grun.) Cleve **var. LATA var. nov. Plate 2, fig. 24.**

Differt a typo valvis latio, polis obtusis. Longis valvis 0.0306 mm; latis valvis 0.0068. Costis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear-lanceolate, attenuate towards obtuse ends. Median line filiform with comma-shaped terminal fissures. Axial area narrow, widened to the middle. Central area a transverse fascia widened outwards. Costæ strong, divergent in the middle and convergent at the ends. Length, 0.0306 mm; breadth, 0.0068. Costæ 12 in 0.01 mm. Differs from the type in it broad valves with obtuse ends. Rare.

PINNULARIA KARELICA Cleve var. SUBCAPITATA var. nov. Plate 3, fig. 7.

Differt a var. japonica Hust. valvis marginem parallelis polis subrostratis. Longis valvis 0.054 mm; latis valvis 0.01. Costis 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and broad-rostrate ends. Median line filiform, with comma-shaped terminal fissures. Axial area very narrow, central area a rectangular broad fascia. Costæ almost parallel or slightly radiate, moderately convergent at the ends. No longitudinal bands. Length, 0.054 mm; breadth, 0.01. Costæ 9 in 0.01 mm. Differs from var. *japonica* Hust. in its parallel margin and subrostrate ends, and by the absence of longitudinal bands.

PINNULARIA LEGUMEN Ehr. Plate 3, fig. 23.

Pinnularia legumen Ehr., Fr. Hustedt, Bacillar. (1930) 322, fig. 587.

Valve linear, lanceolate, slightly triundulate with produced subcapitate ends. Median line filiform, with large comma-shaped terminal fissures. Axial area widened to the orbicular central area. Costæ strong, divergent in the middle and convergent at the ends, 9 in 0.01 mm. Length, 0.085 mm; breadth, 0.012. Somewhat narrower than the type. Rare.

PINNULARIA SUBSOLARIS (Grun.) Cleve var. ASIATICA var. nov. Plate 1, fig. 2.

Differt a typo marginem parallelis. Longis valvis 0.059 mm; latis valvis 0.01. Costis 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit. I. P. Popov.

Valve linear, with parallel margins and broad-rostrate ends. Median line robust, with distinct comma-shaped terminal fissures. Axial area broad, somewhat less than $\frac{1}{3}$ of the valve breadth. Central area a rectangular fascia, slightly dilated outwards. Costæ radiate in the middle, convergent at the ends, 9 in 0.01 mm, without longitudinal bands. Length, 0.059 mm; breadth, 0.01. Rare.

PINNULARIA DIVERGENS W. Smith.

Pinnularia divergens W. Smith, Fr. Hustedt, Bacillar. (1930) 323, fig. 589.

Valve lanceolate, slightly triundulate, with broad subrostrate ends. Median line filiform, with large comma-shaped terminal fissures. Axial area linear, central suborbicular. Costæ divergent in the middle and convergent at the ends, 8 to 9 in 0.01 mm. Length, 0.107 mm; breadth, 0.018. Costæ more robust than in the type. Infrequent.

PINNULARIA DIVERGENS W. Smith var. ELLIPTICA Grunow. Plate 1, fig. 37.

Pinnularia divergens W. Smith var. *elliptica* Grunow, Fr. Hustedt, Bacillar. (1930) 323, fig. 590.

Valve broad-elliptic. Central area a broad fascia, with distinct, marginal, dark, horsehoe-shaped areas. Length, 0.093 mm; breadth, 0.022. Costæ 8 in 0.01 mm. Infrequent.

PINNULARIA DIVERGENS W. Smith var. UNDULATA Heribaud and Peragallo. Plate 1, fig. 28.

Pinnularia divergens W. Smith var. *undulata* Heribaud and Peragallo, Fr. Hustedt, Bacillar. (1930) 323, fig. 591.

Valve with triundulate margins and a transverse fascia widened outwards with distinct, dark, horseshoe-shaped areas. Length, 0.076 mm; breadth, 0.014. Costæ 9 to $9\frac{1}{2}$ in 0.01 mm. Infrequent.

PINNULARIA EPISCOPALIS Cleve. Plate 3, fig. 26.

Pinnularia episcopalis Cleve, Fr. Hustedt, Bacillar. (1930) 323, fig. 592.

Valve robust, linear, with broad ends. Median line filiform, with large comma-shaped terminal fissures and central nodules

curved to one side. Axial area narrow-linear, central a broad fascia widened outwards. Costæ divergent in the middle and convergent at the ends, without longitudinal bands. Length, 0.127 to 0.2 mm; breadth, 0.034 to 0.04. Costæ 6 to 8 in 0.01 mm. Very common.

PINNULARIÆ TABELLARIÆ

PINNULARIA GIBBA Ehr. Plate 1, fig. 22.

Pinnularia gibba Ehr., FR. HUSTEDT, Bacillar. (1930) 327, fig. 600.

Valve linear-lanceolate, slightly attenuate towards the subcapitate ends. Median line filiform with large comma-shaped terminal fissures. Axial area dilated towards the middle, central area a broad rectangular fascia. Costæ slightly radiate in the middle, convergent at the ends. Length, 0.0459 mm; breadth, 0.0085. Costæ 10 to 11 in 0.01 mm. Common.

PINNULARIA GIBBA Ehr. var. LINEARIS Hustedt. Plate 3, fig. 1.

Pinnularia gibba Ehr. var. *linearis* FR. HUSTEDT, Bacillar. (1930) 327, fig. 604.

Valve narrow, linear, with obtuse, round ends. Length, 0.068 mm; breadth, 0.0068. Costæ 10 in 0.01 mm. Common.

PINNULARIA GIBBA Ehr. fo. POLYMORPHA fo. nov. Plate 1, figs. 3 and 4; Plate 2, figs. 7 and 9.

Differt a fo. subundulata Mayer area centralis fronte viza late transversa dilatata, pone-angusta transversa dilatata. Longis valvis 0.059 ad 0.098 mm; latis valvis 0.006 ad 0.01. Costis 9 ad 11 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, slightly triundulate, with attenuate ends. Axial and central areas on one side of the valve shorter than on the other. Length, 0.059 to 0.098 mm; breadth, 0.006 to 0.01. Costæ 9 to 11 in 0.01 mm. Common.

PINNULARIÆ BREVISTRIATÆ

PINNULARIA BREVICOSTATA Cleve. Plate 2, fig. 5.

Pinnularia brevicostata Cleve, FR. HUSTEDT, Bacillar. (1930) 329, 330, fig. 609.

Valve linear, slightly gibbous in the middle, ends round obtuse. Median line straight and robust. Axial area about $\frac{1}{5}$ of the valve breadth. Costæ interrupted in the middle. Length, 0.132 mm; breadth, 0.013. Costæ 8 in 0.01 mm. Longer than the type. Infrequent.

PINNULARIA ACROSPHAERIA Breb.

Pinnularia acrosphaeria Breb., Fr. Hustedt, Bacillar. (1930) 330, fig. 610.

Valve linear, slightly triundulate. Axial area punctate. Length, 0.068 mm; breadth, 0.012. Rare. Reported from northern Manchuria.

PINNULARIÆ MAJORES

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve, Pantocsek, Fossile Bacillarien Ungarns (1903) 111, pl. 7, fig. 113.

Infrequent. Length, 0.204 mm; breadth, 0.027. Costæ 6 to $6\frac{1}{2}$ in 0.01 mm.

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve fo. NEGLECTA Mayer. Plate 1, fig. 16.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* Mayer, Fr. Hustedt, Bacillar. (1930) 331.

Valve linear, with broad-rounded ends. Median line straight, very robust, with lunate terminal fissures. Axial area about $\frac{1}{3}$ of the valve breadth. Costæ almost parallel, very slightly radiate in the middle and convergent at the ends. Longitudinal band distinct. Length, 0.102 mm; breadth, 0.015. Costæ 6 in 0.01 mm. Common.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. FALLAX Cleve. Plate 3, fig. 25.

Pinnularia viridis (Nitz.) Ehr. var. *fallax* Cleve, Fr. Hustedt, Bacillar. (1930) 335; A. Schmidt, Atlas Diatom. (1876) pl. 43, fig. 24; pl. 45, figs. 10, 11.

Valve linear, with parallel margins and rounded ends. Median line complex. Axial area about $\frac{1}{3}$ of the breadth of the valve. Central area interrupted to a fascia. Costæ almost parallel, 8 in 0.01 mm. Longitudinal band distinct. Length, 0.08 mm; breadth, 0.012. Striæ more robust than in the type. Infrequent.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. ORIENTALIS var. nov. Plate 1, figs. 9 and 10; Plate 2, fig. 15.

Valvis linearis ad marginem parallelis, polis attenuatis rotundatis. Raphe plicata. Area axillaris sat dilatata, centralis rotundata. Costis in media valvarum parte radiantibus, apices versus convergentibus. Differt a typo valvis linearibus cum marginem parallelis, a var. intermedia Cleve area centralis rotundatis. Longis valvis, 0.059 ad 0.078 mm; latis valvis 0.011

ad 0.0136. Costis 6 ad 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, slightly attenuate at the rounded ends. Median line indistinct, complex. Axial area less than $\frac{1}{4}$ of the breadth of the valve. Central area broad, enlarged. Costæ radiate, convergent at the ends. Longitudinal bands distinct, broad. Length, 0.059 to 0.078 mm; breadth, 0.011 to 0.0136. Costæ 6 to 9 in 0.01 mm. Differs from the type in its linear valves with parallel margins, and from var. *intermedia* Cleve in its rounded central area. Very common.

PINNULARIA GENTILIS (Donk.) Cleve var. SIBIRICA Skvortzow. Plate 1, fig. 7.

Pinnularia gentilis (Donk.) Cleve var. *sibirica* SKVORTZOW, Diatoms collected by Dr. Y. Okada in Nippon I, pl. 2, fig. 2.

Valve linear, slightly gibbous in the middle and indistinctly attenuate toward the rounded ends. Length, 0.119 mm; breadth, 0.017. Costæ 9 to 7 in 0.01 mm. Common. Reported from Lake Kenon, Transbaikalia, Siberia, and from Nippon.

PINNULARIA NOBILIS Ehr. var. PARALLELA Skv. Plate 2, fig. 4.

Pinnularia nobilis Ehr. var. *parallela* SKVORTZOW, Neogene diatoms from environs of Gensan, Korea (1936) pl. 4, fig. 5.

Valve linear, robust, with parallel margins and broad-rounded ends. Median line distinct, complex. Axial area somewhat less than $\frac{1}{4}$ the breadth of the valve, narrow-linear. Central area slightly dilated. Costæ almost parallel, slightly convergent at the ends. Longitudinal band narrow. Length, 0.27 to 0.34 mm; breadth, 0.032 to 0.04. Costæ 4 to 6 in 0.01 mm. Common. Reported as a fossil from Korea. Recent specimens are larger than fossils.

PINNULARIA NOBILIS Ehr. var. DISTINCTA var. nov. Plate 1, fig. 5.

Differt a typo valvis raphe leniter plicata. Longis valvis 0.187 mm; latis 0.025. Costis 6 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in the median line being very slightly complex, and from var. *fossilis* Pant. in its narrow longitudinal band having somewhat attenuate ends and a moderately complex median line. Length, 0.187 mm; breadth, 0.025. Costæ 6 in 0.01 mm. Common.

PINNULARIA STREPTORAPHE Cleve var. INTERRUPTA Skvortzow. Plate 2, fig. 1.

Pinnularia streptoraphe Cleve var. *interrupta* SKVORTZOW, Freshwater diatoms from the environs of Vladivostok, pl. 1, figs. 1, 2.

Valve linear, slightly gibbous in the middle. Length, 0.171 mm; breadth, 0.023. Costæ 4 to 5 in 0.01 mm. Infrequent. Reported from the environs of Vladivostok.

PINNULARIA DISTINGUENDA Cleve var. ASIATICA Skvortzow. Plate 2, fig. 3.

Pinnularia distinguenda Cleve var. *asiatica* SKVORTZOW, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, figs. 4, 14.

Valve linear, with distinct, round, ends. Median line complex. Axial and central area narrow-lanceolate. Striæ slightly radiate. Convergent at the ends. Length, 0.117 mm; breadth, 0.017. Costæ 6 in 0.01 mm. Common. Reported from northern Manchuria.

PINNULARIA DISTINGUENDA Cleve var. SPHAGNALIS var. nov. Plate 1, fig. 6.

Minor et angustior quam forma typica. Longis valvis 0.078 mm; latis valvis 0.01. Costis 8 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and distinct produced ends. Median line complex with comma-shaped terminal fissures and robust central nodules. Axial area $\frac{1}{3}$ the breadth of the valve, central area enlarged. Costæ slightly radiate in the middle and convergent at the ends. Longitudinal band indistinct. Length, 0.078 mm; breadth, 0.01. Costæ 8 in 0.01 mm. Differs from the type in its small size and in its valves being only half as wide. Common.

PINNULARIA ISOSTAURON (Ehr.) Grun. var. ORIENTALIS var. nov. Plate 1, figs. 21 and 23.

Valvis linearis, prae formae angustior et attenuatis. Longis valvis 0.032 ad 0.035 mm; latis valvis 0.0054 ad 0.0065. Costis 12 ad 14 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and slightly attenuate, rounded, ends. Median line indistinct, complex, with comma-shaped terminal fissures. Axial area about $\frac{1}{2}$ the breadth of valve. Central area a rectangular broad fascia. Costæ almost parallel. Length, 0.032 to 0.035 mm; breadth, 0.0054 to 0.0065. Costæ 12 to 14 in 0.01 mm. Differs from the type in its narrower valves and attenuate ends. Very common.

PINNULARIA SPHAGNICOLA sp. nov. Plate 2, fig. 2.

Valvis linearis cum marginem parallelis, polis rotundatis. Raphe directis plicatis, poris terminalis robustus curvatis, poris centralis dilatatis. Area axiliaris sat dilatata, centralis rotun-

data. Costis in media valvarum parte radiantibus apices versus convergentibus. Longis valvis 0.204 mm; latis valvis 0.0136 ad 0.014. Costis 6 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve linear, with parallel margins and broad-rounded ends. Median line distinct complex. Axial area about $\frac{1}{3}$ of the valve breadth. Central area suborbiculate. Costæ divergent in the middle and convergent at the ends. Longitudinal band distinct and narrow. Length, 0.204 mm; breadth, 0.0136 to 0.014. Costæ 6 in 0.01 mm. A distinct species akin to *Pinnularia distinguenda* Cleve. Infrequent.

CYMBELLA AMPHIOXYS (Kütz.) Grun. var. ASIATICA var. nov. Plate 2, fig. 6.

Differt a typo valvis minoris angustis striis robustis. Longis valvis 0.04 mm; latis valvis 0.0042. Striis 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov. Siberia Orientalis. Legit I. P. Popov.

Valve slightly curved, naviculiform, linear, and subrostrate ends. Isolated puncta distinct. Length, 0.04 mm; breadth, 0.0042. Striæ 12 in 0.01 mm. Differs from the type in its smaller size, narrower valve, and more robust striæ. Rare.

CYMBELLA TURGIDA (Greg.) Cleve.

Cymbella turgida (Greg.) Cleve, Fr. Hustedt, Bacillar. (1930) 358, fig. 660.

Valve semielliptic. Length, 0.027 mm; breadth, 0.008. Striæ, ventral 7, dorsal 8 in 0.01 mm. Smaller than the type. Common. Reported from mountain bogs in northern Manchuria.

CYMBELLA TURGIDA (Greg.) Cleve var. MUSCOSA Skvortzow. Plate 2, fig. 26.

Cymbella turgida (Greg.) Cleve var. *muscosa* Skvortzow, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 17.

Valve slightly arcuate, ventral side centrally undulate, dorsal arcuate, ends attenuate. Length, 0.032 mm; breadth, 0.068. Striæ 8 in 0.01 mm. Common. Reported from Kaolingtze, northern Manchuria.

CYMBELLA PERPUSILLA A. Cleve.

Cymbella perpusilla A. Cleve, Fr. Hustedt, Bacillar. (1930) 361, fig. 666.

Valve linear-lanceolate, asymmetrical, with obtuse ends. Length, 0.02 mm; breadth, 0.0035. Striæ 10 in 0.01 mm. Infrequent.

CYMBELLA PERPUSILLA A. Cleve fo. ELONGATA fo. nov. Plate 3, fig. 17.

Differt a typo valvis elongatis semilanceolatis. Longis valvis 0.042 mm; latis valvis 0.005. Striis 8 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Valve elongate, semilanceolate, with ventral side slightly undulate, dorsal moderately arcuate. Ends acute. Length, 0.042 mm; breadth, 0.005. Striæ 8 in 0.01 mm. Differs from the type in its elongate valves. Infrequent.

CYMBELLA GRACILIS (Rabh.) Cleve.

Cymbella gracilis (Rabh.) Cleve, Fr. Hustedt, Bacillar. (1930) **359**, fig. 663.

Valve semielliptic-lanceolate. Ventral side straight, dorsal undulate. Length, 0.0306 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Infrequent.

CYMBELLA GRACILIS (Rabh.) Cleve fo. SPHAGNICOLA fo. nov. Plate 1, fig. 13.

Differt a typo valvis angustior striis robustis. Longis valvis 0.029 ad 0.032 mm; latis valvis 0.005 ad 0.006. Striis 7 ad 9 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Orientalis. Legit I. P. Popov.

Differs from the type in its narrower valves and more robust striæ. Abundant.

CYMBELLA CISTULA (Hemp.) Grunow.

Cymbella cistula (Hemp.) Grunow, Fr. Hustedt, Bacillar. (1930) 363, fig. 676*a*.

Valve boat-shaped. Length, 0.105 mm; breadth, 0.02. Striæ 7 in 0.01 mm. At the ventral side of the central nodule are three puncta, ending the median striæ. Rare.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella heteropleura Ehr. var. *minor* Cleve, Synopsis of Naviculoid Diatoms (1894) 167.

Length, 0.076 mm; breadth, 0.0187. Striæ 10 to 11 in 0.01 mm. Rare.

CYMBELLA TUMIDA (Breb.) Van Heurck.

Cymbella tumida (Breb.) Van Heurck, Fr. Hustedt, Bacillar. (1930) 366, fig. 677.

Valve arcuate with subrostrate, obtuse, ends. A stigma with a fine fissure below the central nodule. Length, 0.051 mm; breadth, 0.017. Very rare.

GOMPHONEMA LONGICEPS Ehr. var. MONTANA (Schum.) Cleve fo. MINUTA fo. nov. Plate 1, figs. 19 and 25; Plate 2, fig. 28.

Differt a var. montana valvis angustior et attenuatis. Longis valvis 0.022 ad 0.034 mm; latis valvis 0.0034 ad 0.0044. Striis 9 ad 12 in 0.01 mm. Habit. in aquis stagnalis prope Lianchiho rivulis, Primorsk Prov., Siberia Occidentalis. Legit I. P. Popov.

Valve clavate-triundulate, the apex broader than the basis. Ends subrostrate. Differs from var. *montana* (Schum.) Cleve in its more attenuate valves. Abundant.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. INTERMEDIA Grunow. Plate 3, fig. 8.

Hantzschia amphioxys (Ehr.) Grun. var. *intermedia* Grunow, A. SCHMIDT, Atlas Diatom. (1921) pl. 329, fig. 4.

Valve arcuate, with long, produced, ends. Length, 0.079 mm; breadth, 0.0085. Keel puncta 8, striæ 15 in 0.01 mm. Infrequent.

NITZSCHIA TRYBLIONELLA Hantz. var. DEBILIS (Arnott) A. Mayer. Plate 1, fig. 24.

Nitzschia tryblionella Hantz. var. *debilis* (Arnott) A. Mayer, FR. HUSTEDT, Bacillar. (1930) 400, fig. 759.

Valve elliptic-lanceolate, with cuneate-obtuse ends. Length, 0.022 mm; breadth, 0.0095. Costæ 12 in 0.01 mm. Very rare. Reported from rocks, Maoershan, northern Manchuria.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. PERMINUTA Grunow. Plate 1, fig. 13; Plate 2, fig. 12.

Nitzschia frustulum (Kütz.) Grun. var. *tenella* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 30.

Valve linear, with subrostrate ends. Length, 0.018 to 0.022 mm; breadth, 0.0025. Keel puncta 8 to 9, striæ 20 to 25 in 0.01 mm. Differs from the type in its more robust striæ. Common.

NITZSCHIA CAPITELLATA Hust. var. MONTANA Skvortzow. Plate 2, fig. 21.

Nitzschia capitellata Hust. var. *montana* SKVORTZOW, Diatom flora of a mountain bog, Kaolingtze, Pin-Chiang-Sheng Province, Manchoukuo (1938) pl. 1, fig. 24.

Valve linear, with parallel margin and attenuate-capitate ends. Length, 0.032 mm; breadth, 0.0034. Keel puncta 7, striæ 35 to 40 in 0.01 mm. Differs from *Nitzschia capitallata* Hust. in the more robust keel puncta. Infrequent. Reported from mountain bogs of northern Manchuria.

STENOPTEROBIA INTERMEDIA (Lewis).

Stenopterobia intermedia (Lewis), FR. HUSTEDT, Bacillar. (1930) 428, 429, fig. 830.

Very rare. Reported from mountain bogs of northern Manchuria.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, Fr. Hustedt, Bacillar. (1930) 435, figs. 844, 845.

Very rare. Reported from mountain bogs of northern Manchuria.

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ILLUSTRATIONS

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12. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
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Fig. 1. *Pinnularia streptoraphe* Cleve var. *interrupta* Skv.
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11. *Eunotia tridentula* Ehr. var. *perminuta* Grun.
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FIGS. 16 and 17. *Eunotia arcus* Ehr. var. *bidens* Grun.

FIG. 18. *Eunotia arcus* Ehr. ?
19. *Eunotia pectinalis* (Kütz.) Rabh. var. *minor* (Kütz.) Rabh. fo. *impressa* (Ehr.) ?
20. *Eunotia arcus* Ehr.
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23. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
24. *Pinnularia divergentissima* (Grun.) Cleve var. *lata* var. nov.
25. *Navicula ignota* Krasske.
26. *Cymbella turgida* (Greg.) Cleve var. *muscosa* Skv.
27. *Eunotia elegans* Oestrup.
28. *Gomphonema longiceps* Ehr. var. *montana* (Schum.) Cleve fo. *minuta* fo. nov.
29. *Navicula cincta* (Ehr.) Kütz. fo. *sphagnicola* fo. nov.

PLATE 3

FIG. 1. *Pinnularia gibba* Ehr. var. *linearis* Hust.
2. *Eunotia monodon* Ehr. var. *koreana* Skv.

FIGS. 3 and 4. *Eunotia praerupta* Ehr.

FIG. 5. *Eunotia papilio* Ehr.
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8. *Hantzschia amphioxys* (Ehr.) Grun. var. *intermedia* Grun.
9. *Eunotia kocheliensis* O. Müll.
10. *Eunotia praerupta* Ehr.
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12. *Eunotia kocheliensis* O. Müll.
13. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *bidens* fo. nov.
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16. *Navicula sohrensis* Krasske var. *parallela* var. nov.
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22. *Eunotia bigibba* Kütz. var. *pumila* Grun.
23. *Pinnularia legumen* Ehr.
24. *Caloneis sphagnicola* Skv.
25. *Pinnularia viridis* (Nitz.) Ehr. var. *fallax* Cleve.
26. *Pinnularia episcopalis* Cleve.

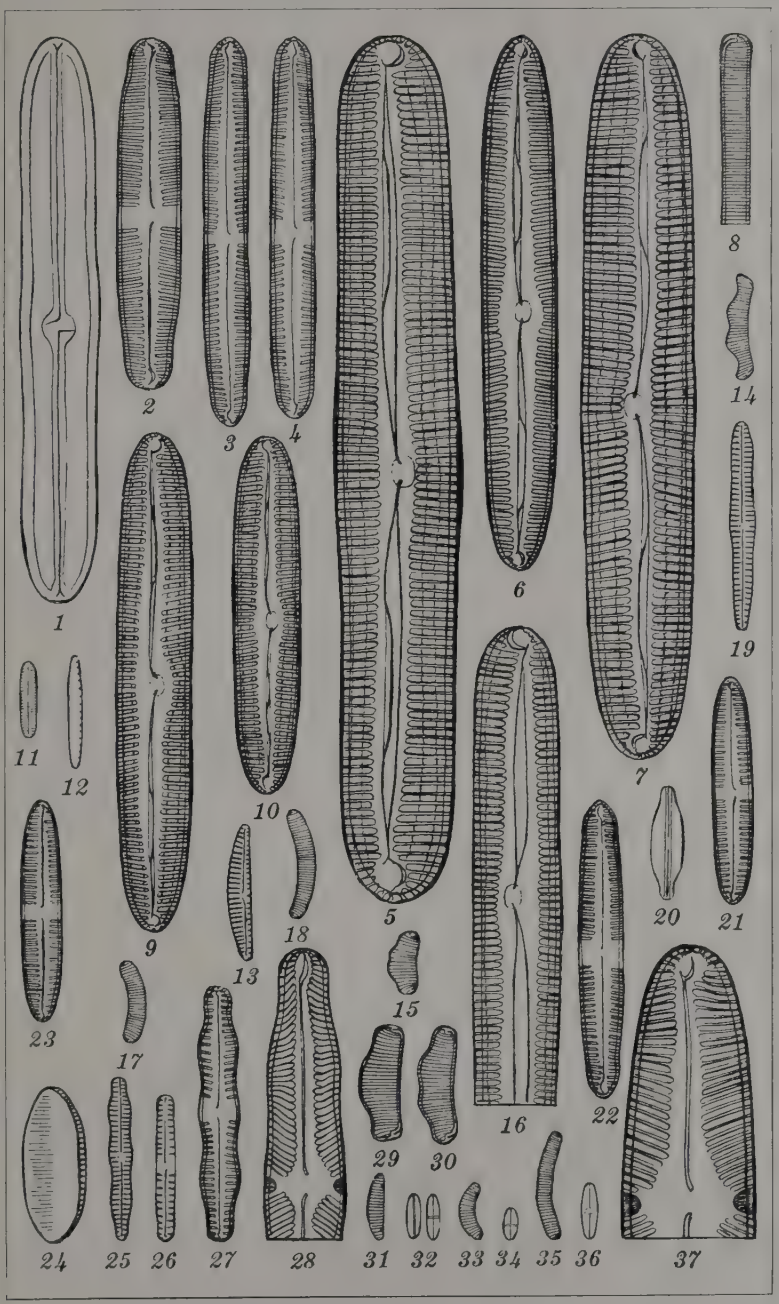
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PLATE 1.

PLATE 2.

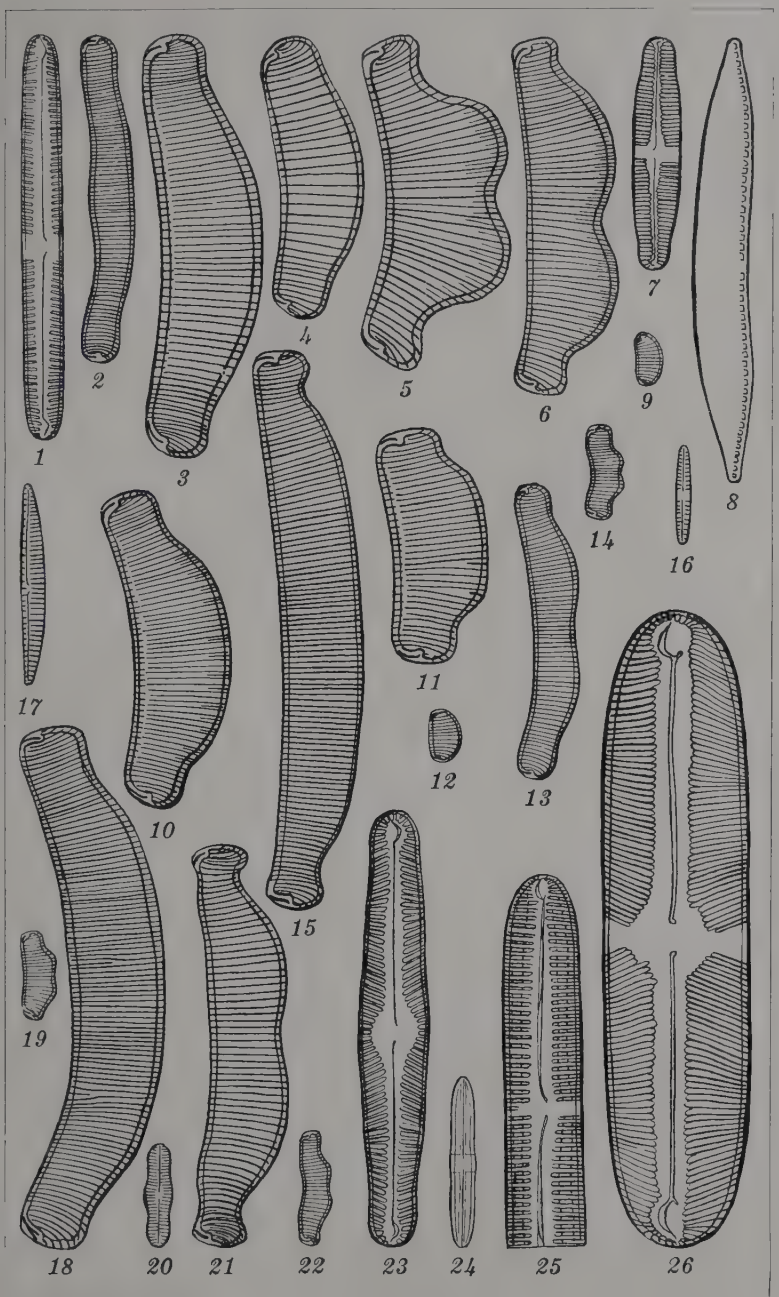

PLATE 3.

THE LITTORAL PAGURIDEA IN THE COLLECTION OF THE UNIVERSITY OF THE PHILIPPINES

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TWO PLATES

The present paper is an attempt to gather together the descriptions of Philippine pagurids scattered in different papers. Included are 30 species and 3 varieties of littoral hermit crabs, of which 2 varieties are new. The species and varieties belong to the following 8 genera: *Cœnobita,* 4 species and a new variety; *Birgus,* one species; *Clibanarius,* 9 species of which a variety is new; *Pagurus,* 9 species; *Aniculus,* one species; *Diogenes,* 2 species; *Calcinus,* 4 species and a variety; and *Eupagurus,* 1 species.

The genera listed above are represented by species that are littoral and even almost terrestial in habit. At Puerto Galera members of *Eupagurus* and *Pagurus* were neither observed to go beyond the shore line nor above the water. *Clibanarius, Calcinus,* and *Diogenes* are littoral or partly terrestial. On the other hand, *Cœnobita* and *Birgus* are almost terrestial and only partially littoral. According to reports, members of the genus *Aniculus* are fossorial although they live in shells.

In the preparation of this paper I am indebted to past members of the Department of Zoölogy, principally to L. D. Griffin, R. P. Cowles, S. F. Light, A. L. Day, and E. Estampador, who have enlarged the pagurid collection of the University of the Philippines. The writer is especially grateful to Dr. H. A. Roxas for constructive criticism and for going over this paper.

THE PAGURIDEA

The hermit crabs belong to the *Paguridea,* a tribe of Anomura, which is a subdivision of the order Decapoda. The Paguridea nearly always have an asymmetrical, imperfectly segmented abdomen which is either soft and twisted or bent under the thorax. Usually the sixth somite and the telson are fully calcified. The terga of the other somites are merely marked by widely separated chitinous plates in the membrane covering the dorsal

surface. The only exception is *Birgus,* which has a symmetrical abdomen and well-calcified terga. The rostrum is generally present but may also be obsolete or absent. The tail fan is atypical and the uropod, when present, is fitted for holding the body in hollow objects, such as shells of snails.

The Paguridea include four families: namely, the Pylochelidæ, the Paguridæ, the Cœnobitidæ, and the Lithodidæ. Of the above families only certain Paguridæ and Cœnobitidæ are commonly found in the Philippines. The Pylochelidæ are exclusively deep-water forms, while the Lithodidæ inhabit shallow waters of the Arctic and Antarctic zones and deep waters of the temperate and tropical regions.

Key to the families of the Paguridea.

a^1. Uropod of telson present; last pair of legs shorter than preceding pair.
  b^1. Pleon straight and symmetrical; provided with five paired symmetrical appendages in addition to the uropods.
    PYLOCHELIDÆ Spence Bate.
  b^2. Pleon either coiled or spiral; paired appendages not present in all abdominal segments.
    c^1. Flagella of first antennæ end in a filament; peduncle of first antennæ shorter than carapace..... PAGURIDÆ Dana.
    c^2. Flagella of first antennæ end bluntly; peduncle of first antennæ either as long as or longer than carapace.... COENOBITIDÆ Dana.
a^2. Uropod of telson absent; last pair of legs as well developed as the preceding pair ..... LITHODIDÆ Dana.

Family PAGURIDÆ Dana

Paguridæ DANA, U. S. Expl. Exped. Crust. pt. 1 (1852) 435.
Paguroidæ BOAS, Vidensk. Selsk. 6; RAEKKE, naturuid. og. math. Afd. 1 2 (1880) 189.
Parapaguridæ SMITH, Bull. Mus. Comp. Zoöl. Harvard 10 (1883) 20; HENDERSON, Challenger Anomura 85; T. R. R. STEBBING, Hist. Crust. 166.
Paguridæ STEBBING, Hist. Crust. (1893) 159.
Paguridæ ALCOCK, Cat. Ind. Crust. 2 Fasc. 1 (1905) 21.

Carapace generally elongate; gastric region well calcified. Rostrum prominent, at times either rudimentary or absent. Flagella often short. Ophthalmic scales and antennal acicles usually large. Abdomen membranous, soft, twisted. Chelipeds generally bulky, left usually larger, although the two may be equal, or rarely the right larger. Walking legs long, usually exceeding length of chelipeds. Penultimate and last pairs slender, either subcheliform or cheliform. Abdominal appendages unpaired, usually on left only; paired in some instances. Left member of telson more developed. Female genital openings

on ventral base of third pair of legs; male genital openings on coxæ of last pair of legs.

The family Paguridæ is subdivided into two subfamilies; namely, Pagurinæ and Eupagurinæ. The subfamily Pagurinæ includes the following eleven genera: *Paguropsis, Paguristes, Clibanarius, Isocheles,* (synonymous to *Holopagurus*), *Cancellus, Petrochirus, Pagurus, Aniculus, Diogenes, Calcinus,* and *Troglopagurus.* Of this number only five have been found represented in the Philippines; namely, *Clibanarius, Pagurus, Aniculus, Diogenes,* and *Calcinus.* Of the subfamily *Eupagurinæ* there are eighteen genera, of which only one, *Eupagurus,* is represented in the Philippines.

Key to the Philippine genera of littoral Paguridæ.

a^1. Third pair of maxillipeds very close at base..... PAGURINÆ Ortmann.
  b^1. Chelipeds equal or slightly unequal; their dactylopodites close and open horizontally ..... *Clibanarius* Dana.
  b^2. Chelipeds subequal, the left generally much larger; their dactylopodites close and open obliquely.
    c^1. Finger apices dark and horny.
      d^1. Chelipeds generally subequal, the left much larger; chelipeds and legs not broken into series of scutella..... *Pagurus* Dana.
      d^2. Chelipeds only slightly subequal; chelipeds and legs broken into a series of scutella..... *Aniculus* Dana.
    c^2. Finger apices white or calcareous.
      d^1. Rostrum absent, its place taken by a rostriform process wedged in between the ophthalmic scales; chelipeds rough and not porcellanous, with no bright colors..... *Diogenes* Dana.
      d^2. Rostrum present; rostriform process absent, chelipeds and legs smooth and porcellanous, often with bright colors. *Calcinus* Dana.
a^2. Third pair of maxillipeds widely parted at base. EUPAGURINÆ Ortmann. Chelipeds unequal, the right vastly larger; fingers calcareous and moving horziontally; abdomen soft, membranous, and twisted on itself..... *Eupagurus* Brandt.

Genus CLIBANARIUS Dana

Clibanarius DANA, U. S. Expl. Exped. Crust. 2 (1852) 461.
Clibanarius HENDERSON, Voy. H. M. S. Challenger 27 (1888) 60.
Clibanarius STEBBING, Hist. Crust. (1893) 160.
Clibanarius MILNE-EDWARDS and BOUVIER, Mem. Mus. Comp. Zoöl. Harvard XIV 3 (1893) 156.
Clibanarius ALCOCK, Cat. Ind. Dec. Crust. 2 Fasc. 1 (1905) 40.

Carapace strongly calcified except branchial region; rostral projection small but distinct. Ocular peduncle slender, with moderately large basal scales lying very close together. Antennal acicle short; flagellum long and nude. Third maxillipeds

very close together at base. Chelipeds either equal or subequal; configuration in the two similar. Fingers moving horizontally with corneous apices and greatly concave inner surface. Crawling legs often with color markings; penultimate legs imperfectly chelate; the last chelate. Abdomen membranous, twisted, well developed. Abdominal appendages of both sexes dichotomous, located on left of second, third, fourth, and fifth somites. Telson asymmetrical, left more developed. Eight species are recorded; one variety, *C. corallinus* var. *spinatus*, is new.

Key to the Philippine species of Clibanarius.

a^1. Propodus of third left leg equal to or longer than dactylus.
  b^1. Propodus of third left leg distinctly longer than dactylus; upper surface of propodus separated from flat lateral plane by a fairly well developed crest.
    c^1. Carapace decidedly elongated; chelipeds and legs pilose, especially outer surface of propodus of third left leg.
      d^1. Ischiopodite of chelipeds without strong tooth on ventral side. *C. corallinus* Milne-Edwards.
      d^2. Ischiopodite of cheliped with strong tooth on ventral side. *C. corallinus* var. *spinatus* var. nov.
    c^2. Carapace slightly elongated; chelipeds and legs scarcely pilose; exposed surface of each leg with a white stripe; distal end of each propodus of legs without colored ring around it. *C. antillensis* Stimpson.
  b^2. Propodus of third left leg equal to the length of its dactylus; upper surface of propodus more or less rounded.
    c^1. Gastric region of carapace, chelipeds, and legs blotched with numerous white spots on a brick-red ground color; dactylus of legs only compressed..... *C. cruentatus* Milne-Edwards.
    c^2. Gastric region of carapace, chelipeds, and legs without spotting, instead with reddish orange and white stripes; propodus of legs remarkably flattened below..... *C. eurysternus* Hilgendorf.
a^2. Propodus of third left leg decidedly shorter than dactylus.
  b^1. Antennular peduncle longer than ocular stalk.
    c^1. Inferior axial border of merus of chelipeds merely serrulate. *C. clibanarius* (Herbst).
    c^2. Inferior axial border of merus of chelipeds provided with a strong tooth ..... *C. infraspinatus* Hilgendorf.
  b^2. Antennular peduncle of same length as ocular stalk.
    c^1. Ocular stalk reaching only front border of carapace.
      d^1. Exposed surface of legs with several stripes. *C. striolatus* Dana.
      d^2. Exposed surface of each leg with only one stripe. *C. sclopetarius* (Herbst).
    c^2. Ocular stalk exceeding length of front border of carapace. *C. padavensis* de Man.

1. CLIBANARIUS CORALLINUS (Milne-Edwards). Plate 1, fig. 11.

Pagurus corallinus MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (3) 10 (1848) 63.

Clibanarius obesomanus (*? corallinus*) DANA, U. S. Expl. Exp. Crust. pt. 1 (1852) 468.

Clibanarius corallinus DE MAN, Archiv. f. Naturg. 53 (1887) 447; ORTMANN, Zool. Jahrb. Syst. 6 (1892) 292.

Clibanarius corallinus ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 48, pl. 5, fig. 1.

Dactylus of third leg shorter than propodus; both flat and heavily set with bristles. Carapace broadened posteriorly, its greatest breadth across gill region about three-fifths its length at sagittal plane; dorsolateral borders of gastric region covered with clusters of moderately long brownish hairs. Setæ of same color covering entire length of ocular peduncle and pedicels of first and second antennæ; rostrum small, hardly exceeding antennal angles of carapace. Ocular stalk slender and longer than front border of carapace, exceeding antennular peduncle by a length equal to its cornea; ophthalmic scales triangular and serrulate, lying very close together. Acicle short and heavily setose especially on lateral distal portion, reaching only base of last segment of antennal peduncle; flagellum long and naked. Chelipeds slightly subequal but similar, more or less heavily hirsute; merus laterally compressed, with a triangular cross section; sharp dorsal border and outer lower surface planted with hair tufts; axial edge serrated. Both dorsal and outer surface of carpus, propodus, and fingers made rugged by numerous conical corneous-tipped tubercles, each with its own tuft of bristles. Hands short and contracted, globular below; fingers dwarfed and broad with corneous tips. Walking legs heavily setose with hair tufts; longer than chelipeds, second pair longest; propodus of second walking leg about twice dactylus; third pair of legs remarkably shorter than second, with propodus and dactylus on left side flattened and very setose.

Previously recorded from Nicobars, Tahiti, Liu-Kiu Islands, New Guinea, Fiji Islands, Malay Archipelago, Andamans, Reef of Coco Islands, and Wake Island.

This species is represented in the University of the Philippines Zoölogical Collection by 8 specimens (0–345 and 0–461) collected from Manila Bay and Medio Islands, Mindoro Province.

2. CLIBANARIUS CORALLINUS var. SPINATUS var. nov.

This variety differs from the type species in the following particulars: (*a*) A strong tooth present on inferior outer border

of ischiopodite of chelipeds; (*b*) propodus of third left leg more distinctly subcarinate on dorsal superior outer border; lower border of carina fringed with tufts of long hairs resembling a curtain; (*c*) body less setose. This new variety is described from three specimens with accession No. 0–552 in the University of the Philippines Collection collected from Puerto Galera, Mindoro Province, by Cowles.

3. CLIBANARIUS ANTILLENSIS Stimpson.

Clibanarius antillensis STIMPSON, Ann. Lyc. Nat. Hist. 7 (1859) 85; BENEDICT, Bull. U. S. Fish. Comm. 20 (1900) 142, pl. 6, fig. 1.

Ocular stalk equal to length of front border of carapace; acicle merely a projecting spinule; dactylus of third left leg shorter than propodus of same leg; white longitudinal stripe on propodus and dactylus of legs oftentimes continued to carpus and merus.

Carapace elongate, its few bristles confined to anterolateral margins and gastric region immediately behind cervical groove; gastric region with numerous small deep pits; rostrum small, in the form of a strong spinule projecting between bases of ophthalmic scales. Eyestalk slender, reaching front border of carapace but slightly exceeding antennular peduncle; cornea nondilated; ophthalmic scales rather approximated, short but broad, their distal outer margin serrate with three or four spinules. Acicle small and spinose, reaching base of last segment of antennal peduncle. Chelipeds equal and similar; merus on dorsal side scabrous; lower inner margin serrulate; carpus short and rather rough, its upper border spinose, with tufts of stiff brownish hairs; hands short, somewhat globular below, spinose; white conical spines present on dorsal surface; stiff bristles arising from base of spines. Ambulatory legs longer than chelipeds; carpi armed with single spine on dorsal margin at distal end; propodus and dactylus of third left leg triangular, its dorsal surface separated from lateral by an overhanging subcarinated crest; dactylus of third left leg shorter than its propodus; merus, carpus, propodus, and dactylus of legs with white longitudinal stripe on external surface; at times stripe also present on inner surface.

This species has been so far reported only from the Antilles and Puerto Rico.

The University of the Philippines collection of about 150 specimens was obtained from Puerto Galera, Mindoro Province, and Taytay, Palawan Province.

4. CLIBANARIUS CRUENTATUS (Milne-Edwards). Plate 1, fig. 8.

Pagurus cruentatus MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (3) 10 (1848) 62.

Clibanarius cruentatus DE MAN, Journ. Linn. Soc. Zoöl. 22 (1888) 250; WHITELEGGE, Mem. Austral. Mus. 3 (1897) 143; ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 50.

Carapace, legs, acicles, and chelipeds with reddish background ocellated with whitish spots. This species is the only one of the genus showing this character. Cephalothorax slightly flattened, making branchial region look somewhat dilated sideways. Chelipeds alike, not much stouter than legs; dorsal surface of hands studded with strong conical tubercles.

Gastric region of carapace, acicles, legs, bases of first and second antennæ, and chelipeds with many whitish spots on brick-red background. Rostrum triangular, acute, prominent, projecting up to bases of ophthalmic scales. Ocular peduncle very long and slender, slightly longer than front border of carapace and equalling length of antennular peduncle. Two chelipeds alike in every respect; superior distal border with prominent spine directed anteriorly; dorsal anterior margin of hand studded with prominent sharp-pointed, dark-tipped tubercles; dorsal surface of fixed finger similarly studded. Chelipeds sparsely setose. Crawling legs not rugged or tuberculose, sparsely setose. Only armature of legs is black-tipped spine on superior distal margin of carpopodite; right members of crawling legs longer than left, both legs surpassing tips of chelipeds; dactylopodites of second pair of legs as long as propodites.

Reported from New Zealand, Mergui, Gulf of Bengal, Funafuti, and Indian Archipelago.

Philippine materials were collected from Taytay, Palawan Province, and Puerto Galera, Mindoro Province.

Color in alcohol either uniform white or yellowish orange; in both cases the white patches on the legs including chelipeds and gastric region of carapace on a brick-red ground color are retained.

5. CLIBANARIUS EURYSTERNUS Hilgendorf. Plate 1, fig. 9.

Pagurus (*Clibanarius*) *eurysternus* HILGENDORF, Monatsb. Akad. d. Wiss. Berlin (1878) 822, pl. 3, figs. 9, 10.

Clibanarius eurysternus DE MAN, Archiv. f. Naturg. 53 (1887) 447; NOBILI, Ann. Mus. Civ. d. Geneva 40 (1899).

Cephalothorax and basal segments of chelipeds and legs depressed; carapace striated with color markings; outer surface

of legs similarly striped; chelipeds similar and equal; dactylus of legs remarkably flattened from below.

Carapace very much compressed; gastric region setose on anterolateral angles. Six longitudinal reddish brown stripes on dorsal surface, two median and continuous, two lateroanterior, and two broken lateroposterior flanking the two median ones. Rostrum exceeding antennal angles of carapace. Ocular stalk with alternate reddish brown and yellowish white longitudinal stripes; equal to anterior border of carapace, noticeably longer than antennular peduncle. Ophthalmic scales approximated, broadly triangular and spinose at free edges. Antennal acicle stout, setose, spinose on top, distinctly overlapping base of last segment of peduncle. Chelipeds and legs including fourth and fifth pairs striped similar to eyestalks. Chelipeds similar and equal, slightly stouter than legs, equal to or slightly longer than carapace. Merus unarmed except for two spines and a tubercle on distal outer lower margin, transversely rugate on blunt dorsal edge, each rugus fringed with yellowish bristles; carpus with a strong spine on distal inner border. Hands and fingers on dorsal surface studded with conical corneous-tipped spines with a cluster of yellowish bristles arising from base of each; fingers when closed meet only at tips. Legs much longer than chelipeds, right legs longer than left. Carpus of legs with sharply pointed, corneous-tipped spine on inner dorsal and distal border; few spines of similar nature also present on distal inferior outer margin of carpus of left leg only. Propodus and dactylus of third legs equal in length, both compressed from below; dactylopodite and propodite of third left leg only provided with spines on superior outer cristiform overhanging borders. Setæ well developed, ornamenting all segments of legs. Abdominal appendages, tail fan not included, four in number, occupying segments 2 to 5; plumose and dichotomously unequal in both sexes.

Known from Mozambique, Malay Archipelago, and Malesia.

Local materials (0–345 and 0–457) obtained from Manila Bay and Puerto Galera, Mindoro Province.

6. CLIBANARIUS CLIBANARIUS (Herbst). Plate 1, fig. 4.

Cancer clibanarius HERBST, Krabben u. Krebse 2 (1791) 20, pl. 23, fig. 1.

Pagurus clibanarius LATREILLE, Hist. Nat. Crust. 6 (1803) 167; OLIVIER, Encycl. Method. 8 (1811) 647.

Clibanarius vulgaris DANA, U. S. Expl. Exp. Crust. pt. 1 (1852) 462; MIERS, Ann. & Mag. Nat. Hist. (5) 5 (1880) 375; DE MAN, Notes Leyden Mus. 12 (1890) 112.

Clibanarius clibanarius HILGENDORF, MB. K. Akad. Berlin (1878) 820; ALCOCK, Cat. Ind. Decapod. Crust. 2 Fasc. 1 (1905) 43, pl. 4, fig. 1.

Eyestalks long and slender, exceeding front border of carapace; antennal acicle spiny, long, and extending well beyond base of last segment of peduncle; chelipeds similar and equal, hands armed with strong spines.

Carapace expanded posteriorly, with tufts of hairs more or less concentrated on proximal portion of branchial region, on cardiac region immediately behind cervical groove, and along anterolateral borders; rostral projection small, triangular, not much more prominent than antennal angles of carapace. Ocular stalk slender and longer than anterior border of carapace but exceeded by antennules; eyestalks and peduncle of both antennæ hirsute; basal scales small, close together, squamiform at base and acute distally, with free spinulate edges. Acicle spiny, long, extending well beyond base of last segment of antennal peduncle. Chelipeds alike, much more massive than walking legs; merus elegantly serrulate at lower inner margin; hand and carpus with strong spine on superior inner border and with closely set conical tubercles on dorsal surface; fingers meeting only at tips. Walking legs more or less granular, all longer than chelipeds; dactyli longer than propodites and much more setose than other segments of legs.

Previously reported from Hongkong, Bay of Bengal, Penang, Pondicherry, Singapore, and Borneo.

Local materials (0–1241) were obtained from Taytay, Palawan Province. Others (0–1738) have no exact locality record.

7. CLIBANARIUS INFRASPINATUS Hilgendorf. Plate 2, fig 4.

Clibanarius infraspinatus HILGENDORF, in v. d. Decken's Reisen Ost-Afric. (1) 3 (1869) 97; ORTMANN, Jahrb. Syst. Zool. 6 (1892) 290; HENDERSON, Trans. Linn. Soc. Zoöl. (2) 5 (1893) 423.

Clibanarius vulgaris DE MAN, Notes on Leyden Mus. (1890) 112.

Resembles *C. clibanarius* in many ways; differs from this species in having a strong blunt spine at inferior border of meropodite of each cheliped and in having more distinct longitudinal striolation of legs and ocular peduncles.

Known from Singapore, Mergui, Bay of Bengal, Sydney, Red Sea, and Tavoy.

University of the Philippines collections (0–151, 0–276, 0–1241 and 0–1398) were obtained from Manila market; Mariveles, Ba-

taan Province; Taytay, Palawan Province; and from Puerto Galera, Mindoro Province.

8. CLIBANARIUS STRIOLATUS Dana. Plate 1, fig. 1.

Clibanarius striolatus DANA, U. S. Expl. Exped. Crust. 1 (1852) 463, pl. 24, figs. 3*a-e;* HELLER, Novara Crust. (1865) 89; DE MAN, Archiv. f. Naturg. 53 (1887) 445; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 46, pl. 4, fig. 7.

Ocular peduncle short and stout, equal to front border of carapace; rostrum short; hands so contracted as to become short and more or less globular.

This species resembles *C. padavensis* in many ways. It differs from the latter with regards to the following: (*a*) rostral projection not so prominent and distinct, not even more prominent than antennal angles of carapace, much less reaching base of basal scales of ocular peduncle; (*b*) eyestalk contracted anteroposteriorly, thicker and shorter, only equalling front border of carapace; cornea correspondingly increased in size; (*c*) hands, like ocular stalk, affected by same contraction, being more massive and shorter; carpus with a more rugged surface and with more bristles; (*d*) dactylopodite of third left leg not as long as that of *C. padavensis.*

Previously reported from Nicobars, Tahiti, Seychelles Islands, Liu-Kiu Islands, Australia, Queensland, Tongatabu, Fiji, Malay Archipelago, Karachi, Mergui, and Persian Gulf.

The specimens in the University of the Philippines Zoölogical Collection (0–1241 and 0–1318) were all obtained from Taytay, Palawan Province.

9. CLIBANARIUS SCLOPETARIUS (Herbst). Plate 1, fig. 6.

Cancer sclopetarius HERBST, Krabben u. Krebse 2 (1796) 23, pl. 23, fig. 3.

Clibanarius sclopetarius BENEDICT, Bull. U. S. Fish. Comm. 22 (1900) 142.

Pagurus tuberculosus MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 229.

Carapace with many slightly elevated platelike granules; dactylus of third left leg longer than propodus; all crawling legs with one longitudinal stripe on external surface of all segments.

Carapace elongate, sparsely setose, with bristles more or less concentrated along anterolateral margins; gastric region deeply punctate, with low scattered squamiform granules; postfrontal suture very prominent, continuous with triangular depression that follows for some distance projection of round-tipped ros-

trum. Eyestalk shorter than front border of carapace, equal to antennular peduncle; eyes nondilated; ophthalmic scale broadly ovate, with a terminal white spine, parted at base but approximated distally. Antennal acicle short, reaching only to more than half penultimate segment of peduncle; inner edge spinose. Chelipeds subequal, right larger; merus, carpus, and hand granulose, granules tending to become laminar tubercles towards upper margin; bristles few, stiff, yellowish, confined on dorsal margin and on underarea of merus, becoming thicker towards extremities; fingers tuberculose, studded with stiff bristle tufts; tips black. Crawling legs very long, exceeding tip of chelipeds, unarmed, except for few tufts of bristles from merus to extremity and for somewhat elevated squamiform granules planted here and there on ischiopodites and meropodites; external surface of legs with longitudinal stripe; dactylus of third left leg subcylindrical, slightly curved, with black tip, and longer than propodus of same leg.

The writer doubts the position of this species. Our specimens partly agree with *Cancer sclopetarius* Herbst, in that the olive-green color mentioned by Benedict and the longitudinal stripe of reddish orange or dull brown on the external surface of crawling legs are retained. Milne-Edwards mentioned that in *Pagurus tuberculosus* the chelipeds are merely granulose, a character also true in the species under study. However, Milne-Edwards did not mention squamiform granules such as those found on carapace and legs of our specimens. Milne-Edwards remarked that *Cancer sclopetarius* Herbst is merely the young of his *P. tuberculosus*.

Our specimens are provisionally identified as *C. sclopetarius*.

Reported from the Antilles and Puerto Rico.

University of the Philippines zoölogical materials (0–459, 0–1241, 0–1900, and 0–1902), composed of 36 specimens, were collected from Puerto Galera, Mindoro Province, and Taytay, Palawan Province.

10. CLIBANARIUS PADAVENSIS de Man. Plate 1, fig. 5.

Clibanarius padavensis DE MAN, Journ. Linn. Soc. Zoöl. 22 (1888) 242, pl. 24, fig. 1; HENDERSON, Journ. Asiat. Soc. Bengal 2 (1896) 520; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 44, pl. 4, fig. 2.

Eyestalk exceeding length of front border of carapace; chelipeds alike in every detail; dactylus of third left leg very much longer than its propodite; stripes on legs longitudinal.

Carapace broadened posteriorly, more fine bristles on dorsolateral margins of gastric region than on lateral sides; rostrum moderate but with tip as long as or exceeding somewhat base of ophthalmic scale. Ocular stalk about same length as antennular pedicel but distinctly longer than front border of carapace; eyes small and subreniform; ophthalmic scales very close together, spinose on their free border. Antennal acicle hairy, short, hardly reaching base of last segment of peduncle. Chelipeds identical, somewhat stouter than legs, with one or two small thornlike spines on distal lateral and inferior border of meropodite; carpopodite studded with a single spine at its distal inner margin; propodus serrulate; dorsal area of fingers palisaded with small black-apexed spines, some of which invade distal outer border of hand; when fingers are closed a hiatus is produced between them. Walking legs surpassing chelipeds, those on the right longer than those on left; propodite of legs more or less subcylindrical, dactylus of third left leg decidedly longer than propodite.

Previously reported from Mergui, Pulicat, Madras, Padaw or King Island, Singapore, and South India.

University of the Philippines zoölogical collections (0–345, 0–1073, 0–1241, and 0–1813) were obtained from Manila Bay; Taytay, Palawan Province; and Puerto Galera, Mindoro Province.

Genus PAGURUS Fabricius

Pagurus Fabricius, Suppl. Ent. Syst. 5 (1798) 411; Dana, U. S. Expl. Exp. Crust. pt. 1. (1852) 449; Henderson, Challenger Anomura (1888) 55.

Dardanus Paulson, Rathbun, Proc. U. S. Nat. Mus. (1903) 33.

Pagurias J. E. Benedict, Bull. U. S. Fish Comm. XX 2 (1900) 141.

Carapace often but not always elongate, highly calcified from cervical groove to front; rostrum obsolete. Eyestalks stout, often constricted towards middle; basal scales far apart, broad at free ends; flagellum long and naked. External maxillipeds juxtaposed at base. Chelipeds usually unequal, rarely equal or subequal, left much larger. Finger apices corneous, somewhat excavated internally. Penultimate pair of legs subchelate. Pleon with four appendages on left side, occupying segments 2 to 5; biramous in male, triramous in female.

This genus is represented by nine species in the collection of the University of the Philippines.

Key to the species of Pagurus.

a^1. Ocular stalk stout, shorter than antennular peduncle; cornea much dilated transversely; right cheliped much smaller than left.

b^1. Dactylus of left cheliped with prominent, serrate vertical crest on dorsal border ..... *P. deformis* Milne-Edwards.

b^2. Dactylus of left cheliped without crest on dorsal border but with blunt tubercles only.

c^1. Entire external exposed area of left hand armed with uniform granules ..... *P. dearmatus* Henderson.

c^2. Only superior outer area of left hand armed with two or three longitudinal series of granules or tubercles, rest entirely smooth. *P. asper* de Haan.

a^2. Ocular stalk moderately long, equalling or slightly exceeding antennal peduncle.

b^1. Sagittal length of carapace longer than width of branchial region.

c^1. Left cheliped much more massive; outer area of left hand armed with sharp spines.

d^1. Exposed surface of last pair of crawling legs with numerous spines.

e^1. Chelipeds and legs very setose; hand of left cheliped not bent inwards.

f^1. Carapace and legs profusely maculated. *P. punctulatus* Olivier.

f^2. Carapace and legs not maculated..... *P. vulnerans* Thallwitz.

e^2. Chelipeds and legs moderately setose; hand of left cheliped bent inwards ..... *P. wood-masoni* Alcock.

d^2. Exposed surface of left hand merely granulose, with few small spines on upper border..... *P. fabimanus* Dana.

c^2. Left cheliped distinctly larger but only slightly longer than right; with broad reddish crossbands on legs; chelipeds and legs setose. *P. euopsis* Dana.

b^2. Sagittal length of carapace only equal to width of branchial region; left cheliped slightly larger than right; very setose; dactylus and propodus of third left leg with transverse imbricating plates on outer surface..... *P. guttatus* Olivier.

1. PAGURUS DEFORMIS Milne-Edwards. Plate 1, fig. 10.

Pagurus deformis Milne-Edwards, Ann. Sci. Nat. Zoöl. (2) 6 (1836) 272; Alcock, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 88, pl. 9, fig. 4.

Pagurus cavipes White, P. Z. S. (1847) 122.

Pagurus cultratus White, List Crust. Brit. Mus. (1848) 60.

Eyestalk stout, dilated distally, shorter than front margin of carapace; dactylus of left cheliped beset with a serrated vertical crest along its length; outer surface of left hand with two longitudinal grooves that gradually flatten out before reaching the base of dactylus.

Carapace somewhat flattened, naked except for line of hair tufts along anterolateral margins. Eyestalk stout, short, depressed, much dilated distally; decidedly shorter than anterior border of carapace and as long as or scarcely longer than antennal peduncle; corneal area transversely reniform; antennal acicle hirsute, serrated, distinctly longer than base of last segment of antennal peduncle. Legs and cheliped sparsely hairy; right cheliped much smaller than left; inferior inner border of merus of left cheliped "strongly alate but irregularly serrate;" [1] upper extensor surface of carpus with strong spines which are largest along upper and inner borders; outer surface of hand with two grooves that gradually disappear before reaching base of dactylus; inner upper border of hand with a line of sharp teeth interspersed with granules in between; lower margin distinct and crenate, lower outer surface devoid of any armature; upper margin of dactylus with a prominent longitudinal carina. Walking legs almost of the same length; propodite and dactylopodite of third left leg with upper margin of outer surface produced into an elegant, scabrous-edged overhanging crest; extensor surface of dactylopodite prominently grooved, propodite longitudinally and medially ridged.

Previously reported from Tahiti, Andamans, Balabac Straight, Ceylon, Mauritius, Seychelles, West Africa, Mergui, New Ireland, Papiete, South Seas, and Liu-Kiu Islands.

The University of the Philippines specimens were collected from Puerto Galera, Calapan, Mindoro Province, and Taytay, Palawan Province.

Newly collected specimens in alcohol: Carapace gray, shaded with reddish color; legs reddish orange, the color tending to form bands at middle of segment, especially on merus, carpus, and propodus; eyestalk with a brownish ring at base.

2. PAGURUS DEARMATUS Henderson. Plate 1, fig. 6.

Pagurus dearmatus HENDERSON, Voy. H. M. S. Challenger 27 (1888) 58; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 91, pl. 9, fig. 6.

Closely allied to *P. asper* but differing from it in entire outer surface of hand of left cheliped being uniformly studded with conical tubercles.

Unlike *P. asper*, entire outer area of left hand almost uniformly and closely tuberculose; dorsal surface of propodus of

[1] Alcock, loc. cit.

third left leg granulose, while its outer lower lateral side has minute depressions. As in *P. asper*, mobile finger of left pincher granulose and noncarinated above; outer upper margin of propodus of third left leg without carina.

So far reported from Admiralty Island, Ceylon, and Maldives.

The University of the Philippines collections were obtained from Puerto Galera, Mindoro Province.

3. PAGURUS ASPER de Haan. Plate 1, fig. 14.

Pagurus asper DE HAAN, Fauna Japon. (1849) 208, pl. 49, fig. 4; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 90, pl. 9, fig. 5.

Dardanus haani RATHBUN, Proc. U. S. Nat. Mus. (1903) 34.

No vertical serrated carina on dactylus of left cheliped. In its place two rows of conical tubercles.

This form differs from *P. deformis* in having the following characters: (*a*) Sharp serrated crest on dactylus of left cheliped reduced to merely two rows of rounded granules; (*b*) overhanging crest on upper margin of propodus of left leg obsolete or absent; (*c*) a strong longitudinal keel about lower border of outer surface of dactylus of third left leg.

Distribution of the species includes the Andamans, Ceylon, Japan, the Sandwich Islands, Australia, Batjan, and Port Jackson.

Local forms were collected from the shores of Mindoro.

4. PAGURUS PUNCTULATUS Olivier. Plate 1, fig. 3.

Pagurus punctulatus OLIVIER, Encycl. Method. 8 (1811) 639; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 81, pl. 8, fig. 1.

Cancer megistos HERBST, Krabb. u. Krebse 3 (1804) 23, pl. 11, fig. 1.

Pagurus megistos OLIVIER, Encycl. Method. 8 (1811) 639.

Very shaggy, with numerous tufts of reddish hair; carapace, maxillipeds, abdominal terga, legs, cheliped, and tail fan copiously marked with white-centered and black-rimmed ocelli.

Carapace slightly compressed, its breadth across gill region two-thirds its sagittal length; anterolateral borders of carapace with clumps of hairs. Ocular stalk subcylindrical, strongly reniform, with eyes slightly dilated; peduncles considerably shorter than antennular but longer than antennal stalk. Acicle spinulose. Chelipeds and walking legs, especially dactylopodites, propodites, and carpopodites, provided with thick clusters of red setæ and dark-tipped spines; inner border of ischiopodite and

meropodite, along length of superior border of carpopodite and hand of left cheliped, strongly toothed. Left cheliped much larger than right; crawling legs, maxillipeds, carapace, tail fan, and pleonal terga profusely maculated with white-centered, dark-edged ocelli.

Known from Andamans, Nicobars, Mergui, Tahiti, Laccadives, Madagascar, Sumatra, Celebes, Australia, Liu-Kiu Islands, and Mozambique.

All the specimens in the University of the Philippines collection were collected from Puerto Galera and Calapan, Mindoro Province; and Taytay, Palawan Province.

5. PAGURUS VULNERANS Thallwitz. Plate 2, fig. 11.

Pagurus vulnerans THALLWITZ, Abh. u. Ber. K. Zoöl. Mus. No. 3 (1890) 33; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 83.

Very setose, like *P. punctulatus*, but lacking white-centered dark-edged ocelli; carapace flattened; eyestalk longer than antennular peduncle.

In hairyness, proportion, form, and even in its spinosity, this species could easily be mistaken for *P. punctulatus* but for the following differences: Carapace of *P. vulnerans* compressed dorsoventrally; ocular peduncle as long as anterior border of carapace and a bit longer than antennular peduncle; no white-centered black-edged ocellation on carapace, maxillipeds, legs, and abdominal terga.

Previously known from Persian Gulf, Coromandel, and Bay of Bengal.

Our materials, 0–450 and 0–1429, were taken in Puerto Galera, Mindoro Province, and from Balabac Strait, Palawan Province, respectively.

6. PAGURUS WOOD-MASONI Alcock.

Pagurus wood-masoni ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 85, pl. 9, fig. 3.

Carapace, chelipeds, and legs scarcely penicillate; bristles yellow, red, or brownish red, always with white tops; dactylus of third left leg with a longitudinal canal on exposed surface; hand of left cheliped bent inwards.

Carapace dorsoventrally compressed, its length about one-eighth longer than its greatest breadth. Ocular stalk globular below, flattened above, slightly shorter than anterior border of carapace and as long as antennal peduncle; cornea of eyes

strongly reniform and moderately dilated. Acicle slender. Chelipeds and legs scarcely pilose; left cheliped decidedly but not greatly larger than right; left hand long, narrow, slightly bent inwards; borders of merus, especially inner, spiny; upper border and outer area of carpus spinose; hand and mobile finger studded with spines; superior margin of hand with two rows of strong spines, its lower edge serrated, appearing as a serrated crest. Ambulatory legs very long, exceeding tip of large cheliped; those on right longer than their left counterparts; carpus of legs distally beset with slender spines; many spinules along upper area of propodus and dactylus of each leg; dactylus of each leg with longitudinal furrow on external surface.

Known from Andamans, MacPherson Strait, and Maldives.

The University of the Philippines specimens were collected in Puerto Galera, Mindoro Province.

7. PAGURUS FABIMANUS Dana. Plate 1, fig. 2.

Pagurus fabimanus DANA, U. S. Expl. Exped. Crust. 1 (1852) 454, pl. 28, fig. 7*a-c;* ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 84, pl. 8, fig. 2.

Eyestalk either as long as or slightly longer than anterior border of carapace; outer surface of big cheliped nonsetose, planted with tiny spiniform granules, which lose their prominence towards lower border; lower border sharply distinct from rest by becoming carinated; outer surface of propodus of third left leg separated from dorsal surface by a sharp dorsolateral edge.

Carapace slightly depressed, almost devoid of any bristles except for small tufts on anterolateral angles. Eyestalk somewhat broadened anteriorly, as long as or a bit longer than front margin of carapace. Acicle short. Only small cheliped and dactyli of legs with marked setæ; right cheliped much smaller than left; merus of left cheliped spinulose at distal lower outer margin; carpus, hand, and dactyli similarly beset with spinules on upper borders; lower border of hand delimited, either entire or crenulate. Last and penultimate segments of third left leg roughened, their outer surface flat and both upper and lower edges boldly relieved; dactylus of same leg with a canal along its entire length of the external surface.

Reported from Minnokoy, Mozambique, Funafuti, Tongatabu, Maldives and Laccadives, and Fiji.

This species (0–721) had been collected from Puerto Galera, Mindoro Province.

8. **PAGURUS EUOPSIS** Dana. Plate 1, fig. 7.

Pagurus euopsis DANA, U. S. Expl. Exped. Crust. 1 (1852) 452, pl. 27, figs. 6*a-c;* ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 86, pl. 9, fig. 2.

Pagurus depressus HELLER, S. B. K. Adad. Wien 46 (1861) 248; HILGENDORF, M. B. K. Akad. Berlin (1878) 814; DE MAN, Archiv. f. Nat. 53 (1) (1887) 431.

Eyestalk moderately long, as long as front margin of carapace and antennular stalk; cornea not dilated distally, specimen moderately hairy; walking legs with transverse wide reddish bands.

The specimens in our collection agree with *P. punctulatus* and *P. euopsis* in hairyness and spinosity of chelipeds and legs. They differ, however, from *P. punctulatus* in having much less numerous thornlike spines, especially on the legs. On the other hand, they agree with *P. euopsis* as described by Dana in the following manner: Carapace more depressed than in *P. punctulatus;* legs and chelipeds thickly provided with stiff, long, brownish bristles; disproportion between chelipeds much less prominent; propodus of third left leg flattened out on outer side, half as wide as long; gastric region of carapace with a large reddish orange patch which differs in color from the one described. Legs and chelipeds yellowish orange with white and red flecks, meri and carpi of both pairs of walking legs with broad dull brick-red crossbands that almost form complete rings.

Previously known from Tongatabu, Samoa, Seychelles, Mauritius, Andamans, Amboina, and Malay Archipelago.

Specimens in the University of the Philippines Zoölogical Collection (0–721 and 0–1536) were all gathered from along the coast of Mindoro.

9. **PAGURUS GUTTATUS** Olivier. Plate 1, fig. 13.

Pagurus guttatus OLIVIER, Encycl. Method. 8 (1811) 640; DE MAN, Abh. Senckenberg. Nat. Ges. 25 (1902) 738; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 87, pl. 9, fig. 1.

Pagurus setifer HESS, Archiv. f. Nat. 31 (1865) 151; HASWELL, Cat. Austral. Crust. (1882).

Eupagurus setifer HASWELL, Cat. Austr. Crust. (1882) 154.

Carapace very much depressed; specimen very setose; a bald smooth patch on carpus of all legs and chelipeds is characteristic of the species.

Carapace greatly compressed with clumps of yellow bristles on anterolateral margins; greatest breadth equal to length of its sagittal line. Eyestalk slightly dilated; distinctly shorter than anterior border of carapace. Acicle hairy, bifid at tip, just reaching base of last segment of antennal peduncle. Chelipeds

and legs beset with long red bristles, forming a thick longitudinal brush on lower outer border of palm and along both upper and lower borders of last three joints of third left leg. Right cheliped slightly smaller than left; a bald smooth area on dorsal surface of carpi of chelipeds and legs easily distinguishes this form from all other species of *Pagurus;* ventral surface of dactylus and propodus of third left leg transversely scutellated by a series of overlapping plates.

This species has been so far reported from Mozambique, Sandwich Islands, Minnokoy, South Seas, Ibo, and Australia.

The lone specimen (0–1920) in the University of the Philippines collection was collected in Puerto Galera, Mindoro Province.

Genus ANICULUS Dana

Aniculus DANA, U. S. Expl. Exped. Crust. 1 (1852) 460.
Aniculus STEBBING, Hist. Crust. (1896) 160.
Aniculus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 94.

Chelipeds and legs protected by more or less regular, crosswise, overlapping scutelike scales, the free edges of which are beautifully fringed with short cilia; chelipeds alike in size and shape, fingers short, somewhat horseshoe-shaped and deeply excavated internally; each biramous pleonal appendage in female covered by a large leaflike broad flap.

This genus appears to be intermediate between *Clibanarius* and *Pagurus*. Like the former it has a slender eyestalk and a distinct rostral projection. Like the latter it is very setose. Its body is similar to that of *Pagurus* in form and proportion of parts. It resembles both in having (*a*) external maxillipeds approximated at base; (*b*) antennal acicle short; (*c*) flagellum long and naked; (*d*) the fourth pair of legs subchelate. Unlike *Pagurus* it has a prominent rostrum. It differs from *Clibanarius* in having its chelipeds equal and similar.

ANICULUS ANICULUS (Herbst). Plate 2, fig. 2.

Cancer aniculus HERBST, Krabben u. Krebse 2 (1791) 37.
Pagurus aniculus FABRICIUS, Ent. Syst. 2 (1793).
Aniculus aniculus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 94, pl. 7, fig. 6.
Pagurus ursus OLIVIER, Encycl. Method. 8 (1811) 640.
Aniculus typicus ORTMANN, Zool. Jahrb. Syst. 6 (1892) 289.

Very shaggy; chelipeds and legs broken into series of transverse imbricating plates; each plate fringed with stiff short cilia.

Carapace strongly calcified except around branchial region; width of branchial region about four-fifths sagittal length; ros-

trum broadly triangular, reaching well beyond base of ophthalmic scales. Antennal scale projecting beyond base of ultimate segment of antennal pedicel; flagellum long and naked. Ocular peduncle equal to length of second antennal pedicel, its scale with bifurcate apex; chelipeds alike in size and shape; ventral distal surface of merus with a socketlike depression for the reception of the carpus in retraction; scutella of chelipeds and some of legs oriented with spiniform tubercles on their free edges. All walking legs much longer than chelipeds, their dactyli nearly as long as propodites. Female pleonal appendages concealed under a broad leaflike bract or broad flap.

Professor Cowles remarked that individuals were found inhabiting burrows. Residents of Puerto Galera have informed the writer that this species is found not infrequently going around without its shell.

Previously reported from Auckland, Mozambique, Mauritius, Seychelles, Japan, Simoda, Wake, Paumotu, South Seas, India, Gulf of Manaar, and Rodriguez.

The specimens in the University of the Philippines collection (0–60, 0–170, and 0–377) were obtained from Puerto Galera, Mindoro Province.

Genus DIOGENES Dana

Diogenes DANA, U. S. Expl. Exped. Crust. 1 (1852) 438.
Diogenes HENDERSON, Voy. H. M. S. Challenger 27 (1888) 53.
Diogenes STEBBING, Hist. Crust. (1893) 160.
Diogenes ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 59.

Carapace elongated, with strongly calcified gastric region. No rostral projection, instead a rostriform process wedged in between ocular stalks. Ocular peduncle slender; ophthalmic scales broad, flanking rostriform process. Antennal acicle quite stout at base; antennal flagellum setose. Right cheliped smaller than left; finger apices pointed and calcareous. Walking legs with long dactylopodites, penultimate pair subcheliform and last chelate. Pleon well developed, membranous, twisted. Four abdominal appendages on left side, aside from telson. Those of male single; in female first three dichotomous.

There are two species in the collection of the University of the Philippines.

Key to the Philippine species of Diogenes.

a^1. Eyestalk in length equal to anterior border of carapace; hand of left cheliped long, narrow, twice as long as broad..... *D. avarus* Heller.
a^2. Eyestalk only slightly surpassing anterior border of carapace; hand short, only slightly longer than wide..... *D. brevirostris* Stimpson.

1. DIOGENES AVARUS Heller.

Diogenes avarus HELLER, Novara Crustacea (1865) 83, pl. 7, fig. 2; DE MAN, Journ. Linn. Soc. London 22 (1888) 236; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 68, pl. 6, fig. 6.

Rostriform process shorter than ophthalmic scale. Left cheliped larger than right, hand long and narrow with the immobile finger somewhat deflected outwards.

Carapace more or less nude dorsally though sparsely hirsute laterally; anterolateral angles serrulate. Mobile rostriform process merely a slender spinule, shorter than ophthalmic scale. Eyestalk stout and contracted; cornea large but not dilated; ophthalmic scale squamifom, triangular, denticulated on anterolateral margin. Antennal peduncle decidedly shorter than antennular; flagellum short, more setose below than above, each with three brownish orange rings; acicle merely a spine. Left cheliped much larger than right; carpus longer than merus; proximal area of palm produced into a short ridge that abruptly merges into general surface; immobile finger deflected outwardly. Right cheliped more pilose than left. Crawling legs smooth except for spinules and bristles on anterior dorsal margin of both carpus and propodus; dactyli pilose, longer than propodi. Legs, like flagella, provided with orange-colored rings on a whitish backgound. Rings strongly marked on propodites, becoming fainter on carpi and more so on meri.

Heretofore recorded from Nicobar, Mergui Islands, Singapore, Madras, Persian Gulf, and East Africa.

University of the Philippines collection specimens (0–1924) were gathered in Puerto Galera, Mindoro Province.

2. DIOGENES BREVIROSTRIS Stimpson.

Diogenes brevirostris STIMPSON, Smithsonian Misc. Coll. 49 (1907) 201, pl. 19, fig. 2.

Rostriform process shorter than ophthalmic scale; left cheliped very rough with calcareous granules; posterior portion of outer surface of hand produced into an oblique inferoposterior crest.

Carapace smooth at center but roughened by platelike ridges towards sides; anterior margin crenulate; rostriform process merely a thin and very short spinule reaching halfway beyond ophthalmic scale. Eyestalk short and stout, but equal to or slightly surpassing front border of carapace; cornea somewhat dilated; ophthalmic scale, whose antero-internal edge is serrulate, broadly triangular. Antennal peduncle longer than eyestalk, but decidedly shorter than antennular; acicle finely spinulate on

dorsal side, short; flagellum naked, shorter than carapace. Chelipeds naked, left much larger than right, general surface of both chelipeds rough with numerous subspiniform granules; superior border of merus crenulate, crenules becoming spinules distally; lower border also crenulate, distal outer margin unarmed except for few spinules on superior edge; carpus rough, upper edge serrated; a toothed lamina, from base of which several spines extend dorsad, on outer surface on median distal portion. Hand rough with pearly spiniform granules; external surface with an oblique inferoposterior crest in addition to a concave linear series of white granules occurring halfway between crest and superior margin; dactylus with longitudinal carina broken into a linear series of transverse laminar teeth. Right cheliped setose with carpus longitudinally grooved above, furrow reaching extensor surface of palm; superior margin of carpus beset with sharp spines. Crawling legs slender; upper border of carpus denticulated; propodus almost smooth above; dactylus setose, laterally compressed with a groove on outer surface.

Previously known from Simon's Bay (Cape of Good Hope), Faden, Monrovia, and Cape Verde Islands.

The lone specimen in the University of the Philippines collection has been obtained from Taytay, Palawan Province.

Genus CALCINUS Dana

Calcinus DANA, U. S. Expl. Exped. Crust. 1 (1852) 456.
Calcinus HENDERSON, Voy. H. M. S. Challenger 27 (1888) 61.
Calcinus ALCOCK, Cat. Ind. Decapod Crust. 2 Facs. 1 (1905) 51.

Carapace small, with distinct rostrum. Ocular stalk long and slender; basal scales small and close together. Antennal acicle short; flagellum naked. External maxillipeds close at base. Left cheliped much larger than right; finger apices of both chelipeds calcareous, concavely hoofed. Penultimate pair of legs cheliform, last chelate. Chelipeds, legs, and gastric region porcellanous. Ambulatory legs with short dactylopodites. Pleon soft, membranous, twisted; dorsal terga far apart; no paired appendages except telson. Four pleonal appendages biramous in both sexes.

There are four species of this genus in the University of the Philippines Zoölogical Collection.

Key to the Philippine species of Calcinus.

a^1. Ocular stalk equal to front border of carapace; superior border of right hand entire; propodus and dactylus of last crawling legs naked on caudal border ..... *C. herbstii* de Man.

a^2. Ocular stalk greatly exceeding length of front border of carapace; superior margin of right hand serrated; dactylus and propodite of legs more or less hirsute.

b^1. Legs with rings of variable colors; fingers beset with pearly granules. *C. elegans* (Milne-Edwards).

b^2. Legs without rings or crossbands.

c^1. Inferior margin of left hand entire, not produced into a toothed carina; proximal ends of dactyli of second and third pair of legs either violet or purple..... *C. terræ-reginæ* Haswell.

c^2. Inferior margin of left hand produced into a toothed carina. *C. latens* (Randall).

1. CALCINUS HERBSTII de Man. Plate 2, fig. 5.

Calcinus herbstii DE MAN, Archiv. f. Naturg. 53 (1887) 437; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 53, pl. 5, fig. 4.

Pagurus tibicen MILNE-EDWARDS, Ann. Sci. Nat. Zoöl. (2) 6 (1836) 278.

Pagurus lævimanus RANDALL, Journ. Acad. Phila. 7 (1839) 135.

Ocular stalk as long as front border of carapace, but exceeding length of antennular peduncle; chelipeds entirely smooth, left much larger. Carpus of left cheliped provided with oblique groove on outer surface.

Rostrum small but distinct. Ocular peduncle slightly curved laterally, almost as long as anterior border of carapace, longer than antennular peduncle; basal scale small, triangular, acute. Antennal acicle short, spinose on dorsal border; flagellum nonsetose, exceeding length of carapace. Chelipeds completely smooth, left vastly the larger; exterior surface of carpus engraved with an inwardly directed canal which fades out before reaching superior border; both fixed and mobile fingers when closed resting against each other throughout entire length; both beset with few hair tufts on concave inner borders. Crawling legs much shorter than left cheliped; legs smooth, with a spinule at distal superior margin of carpopodite; dactylopodite much shorter than propodite and ornamented with few tufts of bristles on ventral edges; longitudinal dark-brown stripe marks exposed surface of brick-red ring around and about tips and a stipling of same color at their proximal ends on exposed surface; tarsi black.

Known from Nicobars, Tahiti, Coco Island, Mauritius, Palk Strait, Mozambique, Zanzibar, Natal, Seychelles, Ceylon, Amboina, Balabac Strait, Sandwich Islands, Wake, Samoa, Paumotu, and Bonin Island.

University of the Philippines materials (0–345, 0–327) were obtained from Pasay, Rizal Province, and Puerto Galera, Mindoro Province.

2. CALCINUS ELEGANS (Milne-Edwards). Plate 2, fig. 10.

Pagurus elegans MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 229.
Calcinus elegans DANA, U. S. Expl. Exped. Crust. 1 (1852) 458, pl. 27, fig. 10; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 55, pl. 5, fig. 2.
Pagurus pictus OWEN, Zoöl. H. M. S. Blossom Crust. (1839) 38, pl. 25, fig. 2.
Pagurus decorus RANDALL, Journ. Acad. Phila. (1839) 134.

Acicle studded with small spines, quite long, even going well beyond base of last segment of antennal peduncle; fingers and adjacent regions of both chelipeds beautifully studded with white pearly granules.

Ocular peduncle slender, much longer than front border of carapace, exceeding antennular pedicel by a corneal length. Acicle spinose, exceeding base of last segment of antennal peduncle. Right cheliped smaller than left; superior border of hand of right cheliped broken into four or five strong teeth. Left cheliped unarmed except for a few spinules on distal margin of meropodite; fingers tongs-shaped. In both chelipeds finger and environs dotted with numerous closely set pearly granules. Walking legs setose on posterior borders; dactylus of second pair of legs thickly planted with closely set hair tufts appearing like a brush.

Reported previously from Tahiti, South Seas, Natal, Mauritius, Seychelles Islands, Liu-Kiu Islands, Sandwich Islands, Wake, Paumotu, New Ireland, and Laccadive Islands.

University of the Philippines Zoölogical Collection 0–327 and 0–333, collected in Puerto Galera, Mindoro Province.

3. CALCIMUS TERRÆ-REGINÆ Haswell.

Calcinus terræ-reginæ HASWELL, Proc. Linn. Soc. N. S. Wales 6 (1881) 760; DE MAN, Archiv. f. Naturg. 53 (1887) 439; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 57, pl. 5, fig. 7.

Acicle quite long, overlapping base of last segment of peduncle; chelipeds unequal, the left slightly the larger; groove on carpus of left cheliped more or less obsolete; hand of right

cheliped reproduced into a sort of vertical crest; dactylus of legs marked with color bandings.

Ocular peduncle slender. Antennal acicle exceeding base of ultimate segment of pedicel; flagellum long. Oblique canal of carpus of left cheliped almost obsolete, its place marked by a white-tipped tubercle; fingers meeting only at tips. Right cheliped with calcareous spinules at superior distal margin of carpus; superior edge of palm produced into a vertical crest broken into four or five teeth; dactylus on same margin broken also into more or less similar serrulation. Walking legs longer than left cheliped; dactyli a bit longer than propodites, white but with purple rings around bases; bristles scarce, thin tufts on lower distal border of carpopodite and lower border of dactylopodite of third pair of legs.

The specimens in the collection of the Department of Zoölogy, University of the Philippines, have their eyestalk asymmetrical, the right the longer. The discrepancy in length varies from one to two corneal lengths.

This species has been reported from Minnokoy, Gulf of Bengal, Malay Archipelago, Mergui Islands, and the West Coast of Australia.

4. CALCINUS LATENS (Randall).

Pagurus latens RANDALL, Journ. Acad. Phila. (1839) 135.
Calcinus latens ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 58, pl. 5, fig. 5.
Calcinus intermedius DE MAN, Notes Leyden Mus. 3 (1881) 102.

Distal superior margin of carpus of cheliped serrated; extensor surface of carpus made rugged by presence of scattered denticles, aside from white-tipped tubercle marking off manifestation of obsolescent oblique groove; superior border of hand and dactylopodite of right cheliped armed with series of anteriorly directed spinules; lower border of hand distinctly produced into a carina broken into a series of sawlike teeth.

Observations on this species are based upon only one specimen. It seems that this species is allied to *C. terræ-reginæ*. Alcock expresses the opinion that this may be the type of the species, and that *C. terræ-reginæ* is merely a variety. However, he keeps the latter as a distinct species. The present writer is of the opinion that since there exist differences wide enough to distinguish one type from the other, the retention of *C. latens* as a separate species from *C. terræ-reginæ* is justified.

This species was previously reported from Sydney, Tahiti, Liu-Kiu Islands, Amani Oshima, Ibo, Mozambique, Sandwich Islands, Fiji Islands, Mauritius, Wake, and Tongatabu.

This lone specimen (0–1923) in the University of the Philippines Zoölogical Collection was obtained from Puerto Galera, Mindoro Province.

Genus EUPAGURUS Brandt

Eupagurus BRANDT, Middendorf's Reise in Sibirien Zool. (1) 2 (1851) 150.
Eupagurus ORTMANN, Jahrb. Syst. Zool. 6 (1891–92) 297.
Eupagurus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 122.
Bernhardus DANA, U. S. Expl. Exped. Crust. 1 (1852) 440.

Carapace strongly calcified about gastric region; rostrum usually distinct. Ocular peduncle either short and stout or long and slender; ophthalmic scales widely separate. Antennal acicle long and slender; flagellum long, either naked or more or less pilose. Third maxillipeds widely separate at base. Chelipeds unequal, the right the larger; fingers with calcareous apices. Penultimate pair of legs subchelate. Abdomen soft, membranous, twisted; four biramous appendages in both sexes.

Under this genus there are only two species so far found in the Philippines; one was collected by the Challenger in 1888, and the other is *Eupagurus janitor* Alcock.

EUPAGURUS JANITOR Alcock. Plate 2, fig. 1.

Eupagurus janitor ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 132, pl. 11, fig. 6.

Eyestalk very short, stout; ophthalmic scale grooved from dorsal area; right cheliped much larger than left; hand broadly ovate with flattened dorsal side. Carapace broadened posteriorly; gastric region polished, tufts of setæ on dorsolateral borders of gastric and lateral sides of branchial regions; rostrum triangular and acuminate, projecting far between the ophthalmic scales. Ocular stalk subcylindrical, much shorter than front border of carapace, stout; eyes dark, bulging laterally. Antennular peduncle shorter than antennal; acicle hirsute, long, narrow, curved, deflected sidewards; flagellum long and naked. Both chelipeds shaggy, with woolly hair. Left cheliped much smaller than right, the former slender; carpus planted with two longitudinal rows of clawlike spines; fingers rounded at tips and greatly excavated internally. Right cheliped clumsy-looking, with hand flattened dorsally, simulating an operculum; hand permanently flexed; merus unarmed; carpus hirsute, bearing a

longitudinal row of clawlike spines on dorsal area; two or three similar spines present on distal superior border; hand much wider than long, even wider than carpus; fixed finger much broader than dactylus; finger apices calcareous. Legs setose, slightly longer than right cheliped. Dactyli of crawling legs ending in black claws, their ventral sides bearing a linear series of sharp amberlike spines. Merus, carpus, and propodus of walking legs with wide crossbands of chocolate-brown; spots of similar color found elsewhere on carapace, legs, and chelipeds.

Previously reported from Halulu Male Atoll and Maldive Islands.

The University of the Philippines materials (0–1517, 0–1521, 0–1922) were collected in Baco Island, and Calapan and Puerto Galera, Mindoro Province.

Family CŒNOBITIDÆ Dana

Cœnobitidæ DANA, U. S. Expl. Exped. Crust. 1 (1852) 432.
Cœnobitidæ STEBBING, Hist. Crust. (1893) 155.
Cœnobitidæ ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 138.

Carapace either elongate or ovate posteriorly. Rostrum prominent or totally absent. Ophthalmic scale small, vertically laminate. Antennular peduncle very long, the first segment deflexed, the other two narrow and subcylindrical. Flagella biramous, truncate. External maxillipeds near each other at base. Chelipeds massive, left decidedly larger than right. Crawling legs very long; last and penultimate pairs reduced, penultimate either cheliform or subcheliform, last cheliform. Abdomen soft, membranous, spiral or simply bent under the cephalothorax and strongly calcified. Male without well-developed and recognizable abdominal appendages except telson. Female with a prominent dichotomous appendage on left side.

Key to the two known genera of the Cœnobitidæ.

a^1. Rostrum degenerate or obsolete; abdomen well developed, soft, twisted, not protected by well-calcified terga..... *Cœnobita* Latreille.
a^2. Rostrum very prominent; abdomen simply bent under distal portion of carapace, not twisted but protected by strongly calcified terga. *Birgus* Leach.

Genus CŒNOBITA Latreille

Cœnobita LATREILLE, Fam. Nat. du Anim. (1812) 276; MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 238; DE HAAN, Faun. Japon. Crust. (1849) 203; STEBBING, Hist. Crust. (1893) 315.

Carapace more or less contracted, solid, strongly tapering anteriorly, the greater portion angular with dorsal surface. Ros-

trum rudimentary. Ocular stalk short, strongly compressed it produces a sharp vertical edge although it appears laminar dorsally; cornea external and terminal. Antennular peduncles very long, stout, cylindrical at base, strongly compressed at their last two distal segments; flagellum dichotomous, upper ramus wider and much longer than lower one. Antennal peduncle pressed laterally. External maxilliped close together at base. Chelipeds unequal, the left vastly the larger; hands short, gradually compressed towards fingers; finger tips calcareous or corneous. Walking legs stout, longer than chelipeds; fourth pair almost rudimentary; fifth cheliform. Abdomen soft, membranous, bent on itself. Three pleonal appendages present on left side, biramous in female and rudimentary in male.

There are only four species and one variety so far known in the Philippines.

Key to the Philippine species of Cœnobita.

a^1. Inner surface of hand of both chelipeds with a triangular brush of hairs.

b^1. Upper outer area of left hand with an oblique series of vertical laminar teeth.

c^1. External area of propodus of third left leg plane, sharply delimited from anterior surface by an obtuse crest; left vas deferens of male not prominently produced ventrally.
C. rugosa Milne-Edwards.

c^2. External surface of propodus of third left leg ventrally concave, not delimited from the anterior surface by a crest; right vas deferens protruding prominently to form a long tube.
C. perlata Milne-Edwards.

b^2. Vertical series of laminar teeth absent, vas deferens retracted inside coxæ of fifth pair of legs..... *C. cavipes* Stimpson.

a^2. Inner surface of hand of right cheliped only with a triangular brush of hairs.

b^1. Ventral margin of left hand without a groove.
C. clypeata (Herbst).

b^2. Ventral margin of left hand with a groove.
C. clypeata puerto-galeræ var. nov.

1. CŒNOBITA RUGOSA Milne-Edwards. Plate 2, fig. 7.

Cœnobita rugosa MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 241; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 143, pl. 24, figs. 3–3*a*.

Cœnobita compressa var. *rugosa* BOUVIER, Bull. Sci. Philom. (8) 3 (1890–1891) 21.

Cœnobita clypeata OWEN, Zoöl. H. M. S. Blossom Crust. (1839) 85.

Cœnobita compressus DE MAN, Abh. Senckenb. Nat. Ges. 25 (1902) 742, pl. 21, fig. 45.

Hands of both chelipeds with a brush of long hairs on inner surface. An oblique series of vertical teeth conspicuous on outer upper area of left palm. Anterior surface of last two segments of third left leg separated from external border by a crest. Acicle free.

Carapace very slightly convex; gastric region almost flat, with four blackish brown spots, two posterior spots in a lyrelike arrangement. Ocular peduncle laterally compressed, almost twice as long as high; scales triangular, sharply pointed. Chelipeds and legs finely granulose, slightly rugulose; a series of oblique and parallel laminar crests on superior border of outer area of hand of left cheliped; propodus and dactylus of third left leg flat on outer surface. Dactyli short, triangular; external and superior border of last two segments of third left leg separated from anterior surface by an obtuse crest. Coxæ of fifth pair of legs in both sexes quite salient, more so in male where right is more salient than left.

Reported from Nicobars, Sydney, Andamans, Ceylon, Laccadive Islands, Madras, Samoa, Mergui Islands, Wake, Sulu Sea, Japan, Mauritius, Mozambique, Bonin, and New Hebrides.

Specimens in the University of the Philippines collection were obtained from Puerto Galera, Mindoro Province; Kolambugan, Lanao Province; and Taytay, Palawan Province.

2. CŒNOBITA PERLATA Milne-Edwards. Plate 2, fig. 3.

Cœnobita perlata MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 242.
Cœnobita purpurea STIMPSON, Proc. Acad. Sci. Phila. (1852) 245.
Cœnobita perlatus ORTMANN, Jahrb. Syst. Zool. 6 (1892) 319, pl. 12, fig. 25; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 145, pl. 14, figs. 2–2*a*.

Vertical series of teeth on outer surface of hand of left cheliped gradually passing anteriorly into an ordinary corneous-tipped conical granule; coxa of right fifth leg of male protruding to form a long vas deferens.

Carapace slightly convex, strongly tumid behind front; gastric region copiously granulated; cardiac and branchial regions punctate. Eyestalks compressed; ophthalmic scale triangular, sharply pointed. Acicle with serrulate or crenulate border, small, merged with second joint of antennal peduncle. External and anterior surface of legs and chelipeds beset with corneous-tipped conical tubercles tending to become spinules towards extremities. A stridulating organ composed of "an oblique series of oblique, laminar tubercles" adorning superior border of ex-

ternal surface of hand of left cheliped; tubercles gradually pass anteriorly into general surface as ordinary conical tubercles. A triangular brush of long hairs present on upper inner borders of both hands. Ambulatory legs moderately setose, more so on the right side; dactyli of right crawling legs slightly flattened; those of left triangular, propodus laterally compressed but not flat, with no prominent crest to separate it from its dorsal plane; dactylus of left legs internally concave, each provided with a serrated longitudinal ridge. Coxa of right last leg of male projecting ventrally into a long tube.

Thus far reported from Nicobars, New Hebrides, Andamans, Laccadive Islands, Japan, Bonin, Fiji Islands, Samoa, and South Seas.

There are nine specimens (0–1903) in the University of the Philippines Zoölogical Collection.

3. CŒNOBITA CAVIPES Stimpson. Plate 1, fig. 12.

Cœnobita cavipes STIMPSON, Proc. Acad. Nat. Sci. Phila. (1852) 254; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 146, pl. 14, fig. 1.

Cœnobita violascens HELLER, Verh. Zool. Bot. Ges. Wien 12 (1862) 524.

Cœnobita compressa MIERS, Ann. & Mag. Nat. Hist. (5) 5 (1880) 371; ORTMANN, Jahrb. Syst. Zool. 6 (1892) 316.

Cœnobita compressus NOBILI, Ann. Mus. Genov. (2) 22 (1900) 495, Fauna and Geog. Mald. and Lacc. Arch. (1) 1 (1901) 97.

Hand of each cheliped with a brush of yellowish hairs about the superior margin on inner surface; acicle merged with second joint of antennal peduncle.

Gastric region stippled with minute depressions; its lateral borders rough, provided with bristles. Eyestalk short, laterally compressed. Ophthalmic scale small, triangular, with very acute apex. Antennal acicle fused with second joint of antennal pedicel. Merus of cheliped traversed by cross-rugulose ridges; carpi studded with small tubercles; similar tubercles arming outer surface of right palm, with one to three bristles arising from base of latter; dactylus of cheliped beset with corneous-tipped spinules; on inner surface and about superior border of both hands a triangular brush of long hairs. Walking legs as long as chelipeds; dorsal surface of last three segments comparatively smooth, finely punctate; right dactylopodites more or less cylindrical, triangular, with flat outer surface.

Reported from Mombas, Java, Borneo, Penang, Mozambique, Nicobars, Mergui Islands, Batjan, Zanzibar, Japan, Kendoa, and Andaman Islands.

The University of the Philippines specimens were collected from the coast of Mindoro; Kolambugan, Lanao Province; Batag, Samar Province; and Taytay, Palawan Province.

4. CŒNOBITA CLYPEATA (Herbst). Plate 2, fig. 12.

Cancer clypeata HERBST, Krabben u. Krebse 2 (1796) 22, pl. 23, fig. 2.

Cœnobita clypeata LATREILLE, Fam. Nat. du Anim. (1828) 277; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 142, pl. 15, figs. 1–1*a*; HELLER, Novara Crust. (1865) 82; ORTMANN, Zool. Jahrb. Syst. 6 (1892) 316; HENDERSON, Challenger, Anomura (1888) 51.

Hand of right cheliped only provided with a triangular brush of long hairs; acicle spear-shaped, not fused with second segment of antennal peduncle.

Carapace well calcified, convex dorsally and copiously pitted; lateral borders of branchial region concave on its anterior half. Ocular peduncle longer than anterior border of carapace, distinctly angular ventrally but appearing subcylindrical dorsally; ophthalmic scale bladelike, with rounded crenulate end. Acicula minute, laterally compressed, free from second joint of peduncle. Meri of chelipeds beset with a series of transverse broken rough ridges; carpi provided with corneous tubercles; hands similarly studded; a brush of long stiff hairs on inner margin of right palm only. Crawling legs pitted; last three segments studded with spinulelike tubercles with black tips, especially on dorsal surface. Coxæ of fifth pair of legs of male modified ventrally to form a protruding vas deferens.

Previously reported from Nicobars, Tahiti, Laccadive Islands, South Seas, West Africa, Te River, and Burma.

The University of the Philippines specimens (0–31, 0–442, 0–1850, and 0–1905) of this species were collected on the coast of Mindoro.

5. CŒNOBITA CLYPEATA var. PUERTO-GALERÆ var. nov. Plate 2, figs. 8 and 9.

Our specimens on close examination show a definite departure from *C. clypeata* as described by Latreille or Alcock. Though the difference does not seem to warrant creation of a new species, the writer believes that, at least, there is justification for the establishment of a new variety under this species. The proposed

variety differs from the type in the following particulars: (*a*) Outer surface of hand of left cheliped very finely granular, almost smooth, except for some pustular tubercles on first third of upper area; (*b*) inferior border of left hand not entire but deeply grooved by an inwardly directed cut near proximal end.

The type (0–1915) of var. *puerto-galeræ* is kept in the Department of Zoölogy, University of the Philippines.

The Philippine materials were collected on the coast of Mindoro.

Genus BIRGUS Leach

Birgus LEACH, Trans. Linn. Soc. 11 (1815) 337.
Birgus MILNE-EDWARDS, Hist. Nat. Crust. 2 (1837) 244.
Birgus HENDERSON, Voy. H. M. S. Challenger 27 (1888) 49.
Birgus ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 148.

Carapace contracted anteriorly, branchial region broad-ovate. Rostrum prominently projecting forward. Ocular peduncle subcylindrical; ophthalmic scale close together, partly covered by downward deflexion of rostrum. External maxillipeds close together at base. Chelipeds of both legs large, the left notably larger. Crawling legs all stout; penultimate and last pairs of legs cheliform, especially the former, which look like regular chelipeds. Abdomen very broad, short, simply bent under cephalothorax, neither twisted nor spiral. Tergal plates of second, third, fourth, and fifth somites strongly calcified, broad, overlapping posteriorly with pleural plates flanking them on either side; tergal plate of sixth somite and tail fan much reduced; ventral surface of abdomen membranous; abdominal appendages attached on left side on segments two to four, those of male rudimentary; those of female hirsute and biramous.

BIRGUS LATRO (Herbst). Plate 2, fig. 13.

Cancer latro HERBST, Krabb. u. Krebse 2 (1791) 34, pl. 24.
Cancer crumenatus RUMPH, Amboinsch. Rariteitk. (1705) 7, pl. 4.
Cancer crumenatus orientalis SEBA, Thesaur. 3 (1761) pl. 21, figs. 1, 2.
Pagurus latro LATREILLE, Hist. Nat. Crust. 6 (1803) 164.
Pagurus laticauda (Latreille) CUVIER, R. A. 18 (1849) pl. 43, fig. 1.
Birgus latro LEACH, Trans. Linn. Soc. 11 (1815) 337; DE HAAN, Faun. Japon. Crust. (1849) 212; DANA, U. S. Expl. Exped. Crust. 1 (1852) 474, pl. 30, fig. 5; ALCOCK, Cat. Ind. Decapod Crust. 2 Fasc. 1 (1905) 15, pl. 16.
Birgus laticauda DESMAREST, Dict. Sci. Nat. 28 (1823) 290.

Carapace ovate and transversely rugulose; rostrum very prominent, partly concealing ophthalmic scales; coxæ of fifth pair of legs not saliently produced in male; much less so in female.

Carapace transversely cut into furrows, the cut tending to become semilunar in the gastric region. Rostrum prominent and acute. Ocular stalk subcylindrical; eyes terminal, somewhat ventral; ophthalmic scales laminar, close together, partially hidden off by ventral deflexion of rostrum. Legs and chelipeds also transversely cut into rugæ which have no tendency to become semilunar; rugose ridges of propodites fringed with short hairs and black corneous tubercles; dactyli of second, third, and fourth pairs of legs broadly spiniform.

Previously known from Ternate, Java, Flinders Island, Liu-Kiu Islands, Paumotu, Amboina, Comoro Islands, Mauritius, and Andamans.

Five Philippine specimens (0–190, 0–706) were collected on Cabro Island, Mindanao Province, and Puerto Galera, Mindoro Province.

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ILLUSTRATIONS

[Unless otherwise stated, the figures are of natural size.]

Plate 1

Fig. 1. *Clibanarius striolatus.*
2. *Pagurus fabimanus.*
3. *Pagurus punctulatus.*
4. *Clibanarius clibanarius.*
5. *Clibanarius padavensis.*
6. *Pagurus dearmatus.*
7. *Pagurus euopis;* × 0.5.
8. *Clibanarius cruentatus.*
9. *Clibanarius eurysternus.*
10. *Pagurus deformis.*
11. *Clibanarius corallinus.*
12. *Cœnobita cavipes;* × 0.5.
13. *Pagurus guttatus.*
14. *Pagurus asper.*

Plate 2

Fig. 1. *Eupagurus janitor.*
2. *Aniculus aniculus;* × 0.5.
3. *Cœnobita perlata.*
4. *Clibanarius infraspinatus.*
5. *Calcinus herbstii.*
6. *Clibanarius sclopetarius.*
7. *Cœnobita rugosa.*
8. *Cœnobita clypeata* var. *puerto-galeræ.*
9. Left cheliped of *Cœnobita clypeata* var. *puerto-galeræ.*
10. *Calcinus elegans.*
11. *Pagurus vulnerans.*
12. *Cœnobita clypeata;* × 0.5.
13. *Birgus latro;* × 0.5.

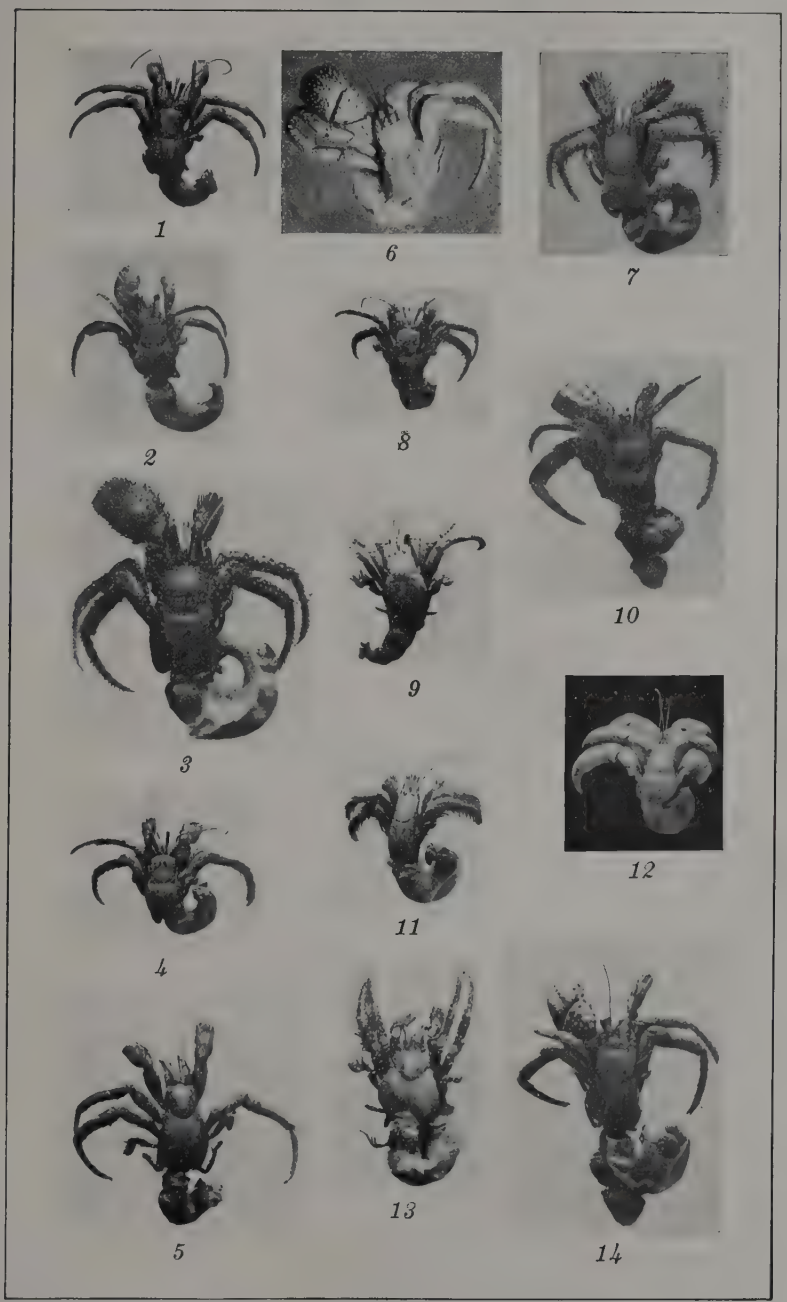

PLATE 1.

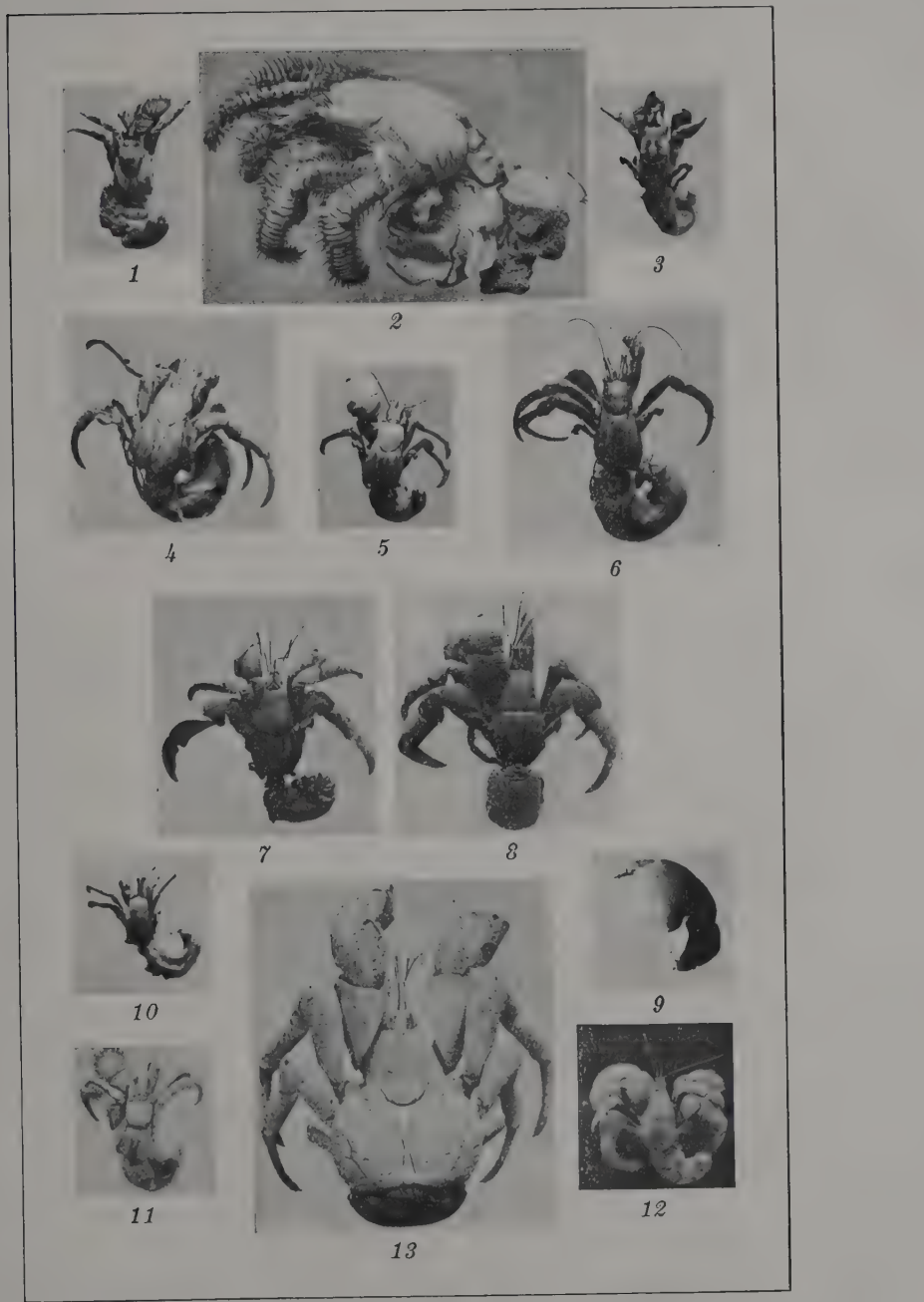

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVII[1]

By CHARLES P. ALEXANDER

Of Amherst, Massachusetts

THREE PLATES

The crane flies herewith considered have been derived from several sources, the chief ones being as follows: Extensive collections from Java and eastern Borneo, collected by Mrs. M. E. Walsh; material from the Khasi Hills, Assam, taken by Mr. S. Sircar; specimens from various provinces in China, taken by Messrs. Franck, Gressitt, and Kellogg; material from New Guinea and the Philippines, preserved in the Museum of Comparative Zoölogy, Cambridge, Massachusetts. Except where indicated to the contrary, the types are preserved in my own collection of these flies. As often in the past, my sincere thanks are extended to the various collectors of this abundant and valuable series of Tipulidæ. A single species of Tanyderidæ, considered as being the most generalized family of crane flies, is described at this time.

TANYDERIDÆ

EUTANYDERUS OREONYMPHA sp. nov. Plate 1, fig. 1.

General coloration gray, variegated with black; antennæ 17-segmented, black throughout; halteres yellow, knob dark brown; femora black, bases broadly yellow; tibiæ black with a broad yellow central ring; wings whitish subhyaline, with four oblique brown crossbands, the third very oblique, extending completely across wing from midlength of cell Sc_1, involving outer end of cell 1st M_2; abdominal tergites black, light gray sublaterally.

Male.—Length, about 15 millimeters; wing, 13; antennæ, about 3.

Rostrum black, dusted with gray, nearly as long as remainder of head; palpi black. Antennæ 17-segmented, black throughout; flagellar segments suboval to subcylindrical, the second shorter than the first, the succeeding segments very gradually decreasing

[1] Contribution from the Department of Entomology, Massachusetts State College.

in size outwardly; terminal segment a little larger than penultimate. Head gray, with black verticils.

Pronotum and cervical sclerites gray, narrowly blackened medially. Mesonotal præscutum light gray, with three very conspicuous black stripes, median stripe very narrowly divided by a pale capillary vitta; setæ of interspaces yellow, conspicuous; scutum gray, each lobe with two blackish areas; scutellum and short mediotergite gray. Pleura and pleurotergite gray. Halteres yellow, knob dark brown. Legs with coxæ gray pruinose; trochanters black, pruinose; femora black, bases broadly yellow, including slightly less than proximal half; tibiæ black, with a conspicuous yellow central ring, subequal in extent to the dark apex and about twice as wide as blackened base; tarsi black. Wings (Plate 1, fig. 1) with ground color whitish subhyaline, conspicuously patterned with brown, including all of cell C excepting a small pale spot near outer end and four solidly darkened, unmargined, darker brown oblique fasciæ, distributed as follows: Basal fascia including anterior prearcular field and a postarcular area to the general level of origin of Rs, sending a distal extension in cell R to beyond midlength of Rs and a narrow seam along vein Cu to second dark fascia; a conspicuous ground area in cell R before origin of Rs, extending into cell M behind; second dark fascia narrow, completely traversing wing at cord, in cells R_4 and R_5 sending a distal extension almost to third band; third band complete, oblique, narrow, almost parallel-sided, extending from costa at near midlength of cell Sc_1, involving outer end of cell 1st M_2; distal band occupying narrow wing apex in cells R_1 to R_4 and extreme outer ends of cells Sc_1 and R_5; additional isolated dark spots include a circular area at fork of Sc and marginal spots at M_1, M_3, and Cu_1; veins yellowish brown, darker in patterned areas. In one wing of type a circular dark spot at fork of R_{2+3}. Venation: Cell R_2 about one and one-third as long as its petiole.

Abdominal tergites light gray laterally, segments broadly and continuously blackened medially, caudal margins of segments more narrowly blackened, on outer segments continued basad along lateral margin to form conspicuous outer lateral triangles; hypopygium black.

Habitat.—New South Wales.

Holotype, male, Mount Kosciusko, altitude 5,000 feet, December 11, 1931 (*A. L. Tonnoir*). Presented by collector to Dr. P. J. Darlington, of the Harvard Australian Expedition; type in the Museum of Comparative Zoölogy, Cambridge, Mass.

Eutanyderus oreonympha is very different from the only other known species of the genus, *E. wilsoni* Alexander, of Victoria, in the larger size, in the increased number of antennal segments, and in the very different pattern of the legs and wings. There are now six species of Tanyderidæ known from Australia and Tasmania, separable by the following key.

Key to the Australian species of Tanyderidæ.

1. A short element R_{4+5} present; antennal flagellum entirely or chiefly black. 2.

   A short element R_{2+3+4} present; antennal flagellum yellow (*Radinoderus* Handkirsch) ..... 4.

2. Free tip of Sc_2 preserved; a supernumerary crossvein in cell R_1. (*Nothoderus* Alexander, Tasmania). *Nothoderus australiensis* (Alexander).

   Free tip of Sc_2 atrophied; no supernumerary crossveins in any of the cells. (*Eutanyderus* Alexander) ..... 3.

3. Antennæ 15-segmented; tibiæ uniformly brown; cell R_2 shorter than its petiole. (Victoria) ..... *Eutanyderus wilsoni* Alexander.

   Antennæ 17-segmented; tibiæ black with a broad central yellow ring; cell R_2 longer than its petiole. (Southern New South Wales).

   Eutanyderus oreonympha sp. nov.

4. Femora yellow, with only the tips blackened. (Southern Queensland). *Radinoderus terræ-reginæ* (Alexander).

   At least the fore femora conspicuously darkened at near midlength.... 5.

5. Wings broad, of normal conformation; wing bands wide, restricting ground color; an apical dark spot in cells Sc_1, R_1, and R_2; medial dark femoral rings conspicuous on all legs. (Northern New South Wales). *Radinoderus dorrigensis* Alexander.

   Wings relatively narrow, tips subfalcate; wing bands narrow; no dark spot at wing tip; median femoral bands of middle legs scarcely evident. (Western Australia). *Radinoderus occidentalis* (Alexander).

All of the previously described Australian species have been figured by the writer.[2] The most recent key to the tanyderid genera, with figures of the wing pattern and venation of the known Australian species, with the single exception of *Radinoderus occidentalis*, has been given by Dr. Inez W. Williams.[3]

[2] Alexander, C. P. The Tanyderidæ of Australia (Diptera). Proc. Linn. Soc. New South Wales 53 (1928) 367–374, figs. 1–4; Observations on the dipterous family Tanyderidæ. Proc. Linn. Soc. New South Wales 55 (1930) 221–230, pls. 5, 6; text fig. 1.

[3] Williams, Inez W. The external morphology of the primitive tanyderid dipteron, *Protoplasa fitchii* O. S., with notes on the other Tanyderidae. Journ. N. Y. Ent. Soc. 41 (1933) 1–35, pls. 1–8, figs. 1–38; text fig. 1.

The only species of the family described since the publication of the last-cited paper is *Protanyderus alexanderi* Kariya, from the Japanese Alps, Central Honshiu.[4]

Whether the Chilean genus *Araucoderus* Alexander can be maintained as distinct from *Eutanyderus* is rendered doubtful by the discovery of the new species described in this paper.

TIPULIDÆ

TIPULINÆ

PSELLIOPHORA ARDENS (Wiedemann).

Ctenophora ardens WIEDEMANN, Dipt. exot. 1 (1821) 20.
Pselliophora ardens OSTEN SACKEN, Berlin. Ent. Zeitschr. 30 (1886) 168.

One male, one female, Tjiangsana, Djampangs, western Java, November, 1936 (*Walsh*). The male agrees entirely with the descriptions and identified specimens, but the female has the wings almost uniformly deep saturated yellow, with a conspicuous dusky cloud at margin along tip of vein 1st A. In this specimen the wing tip, which is darkened in normal individuals, is concolorous with the remainder of the yellow ground.

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

One male, Tjiangsana, Djampangs, western Java, November, 1936 (*Walsh*).

DOLICHOPEZA (OROPEZA) FOKIENSIS sp. nov. Plate 1, fig. 2; Plate 2, fig. 25.

General coloration of mesonotum gray, præscutum with four darker brownish gray stripes; antennæ of moderate length; basal flagellar segments bicolorous, dark with pale apices; legs with tibiæ and tarsi white; wings narrow, strongly suffused with brown, the brownish black stigma preceded and followed by restricted creamy yellow areas; cell 2d A narrow; male hypopygium with the sublateral portions of tergite with low triangular points; ninth sternite bearing oval yellow lobes that are densely provided with microscopic setulæ; ædeagus black, subtended by dusky phallosomic plates.

Male.—Length, about 11 millimeters; wing, 10.2; antennæ, about 3.4.

Frontal prolongation of head yellow above, blackened on sides; palpi with basal two segments dark brown, remaining segments

[4] Kariya, Shojiro. On the Family Tanyderidæ of Japan (Diptera). Mushi 8 (1935) 39–41, pl. 6, figs. 1–7.

black. Antennæ moderately elongate, as shown by measurements; scape and pedicel yellowish white; first flagellar segment pale brown; succeeding three segments brownish black, tip narrowly obscure yellow to produce a bicolored appearance; remaining segments uniformly blackened; flagellar segments subcylindrical, basal portion a trifle thicker; verticils subequal in length to segments, unilaterally arranged. Head light gray, somewhat darker gray on vertex, posterior vertex with a delicate capillary median vitta; anterior vertex wide.

Pronotum gray. Mesonotal præscutum gray, with four darker brownish gray stripes, intermediate pair separated by a line of the ground color, the two stripes confluent behind; posterior sclerites of notum blackened, sparsely pruinose, scutal lobes with cephalic-lateral portion darkened. Pleura obscure yellow, variegated with brownish gray on ventral sternopleurite, anepisternum, meron, and pleurotergite; dorsopleural membrane and pteropleurite pale. Halteres with stem yellow, knob broken. Legs with fore coxæ darkened, pale apically; remaining coxæ yellow, extreme bases darkened; trochanters yellow; femora brownish yellow, tips passing into brown; tibiæ and tarsi snowy white. Wings (Plate 1, fig. 2) with a strong brownish tinge, stigma very conspicuous, brownish black; prearcular and costal regions more suffused than remainder of ground; cell Sc yellow; restricted cream-yellow areas before and beyond stigma; veins brown. Wings narrower than in *shirakiella*. Venation: Rs straight, oblique, longer than basal section of R_{4+5}; cell 1st M_2 wider than in *shirakiella*, especially on basal portion; cell 2d A narrow.

Abdomen variegated obscure yellow and brown, basal rings brighter, more yellowish; a broken median series of longitudinal brown dashes on sternites, lacking on basal rings; hypopygium chiefly pale. Male hypopygium (Plate 2, fig. 25) with tergite, 9*t*, extensive, median area slightly produced into a blackened plate the margin of which is weakly concave; sublaterally the tergal margin bears low triangular points. Ædeagus blackened, subtended by dusky plates, *p*, the apices of which are roughened. What appears to represent the ninth sternite, 9*s*, bears two oval yellow lobes that are densely covered with microscopic pale setulæ.

Habitat.—China (Fukien).

Holotype, male, Gang-keu, altitude 1,900 feet, July 24, 1936 (*Gressitt*).

Generally similar to *Dolichopeza* (*Oropeza*) *shirakiella* (Alexander), of Formosa, differing especially in the longer antennæ, which are fully one and one-half as long as in *shirakiella*, with the flagellar segments correspondingly lengthened, and in the details of structure of the male hypopygium. The subgenus *Oropeza* had not been reported from China.

TIPULA (SCHUMMELIA) BICOLORATA sp. nov. Plate 1, fig. 3; Plate 2, figs. 26 and 27.

General coloration yellow, præscutum and scutum heavily patterned with polished black; pleura yellow, with a transverse brown girdle on episternum; knobs of halteres dark brown; femora yellow, tips blackened; wings bicolorous, basal two-thirds grayish subhyaline, distal third strongly infumed; abdominal segments in part bicolorous, yellow, caudal margins broadly dull black; male hypopygium with tergite complex in structure, dorsal plate bifid.

Male.—Length, about 9 millimeters; wing, 8.8; antennæ, about 3.5.

Frontal prolongation of head pale yellow above, slightly darker on sides; palpi with basal two segments pale brown, intermediate segment paler, terminal segment passing into black. Antennæ moderately elongate, as shown by measurements; scape and pedicel yellow; flagellum uniformly dark brown; terminal segment greatly reduced, oval; verticils shorter than segments. Head polished brown; anterior vertex wide.

Pronotum yellow, weakly darkened medially above. Mesonotal præscutum yellow, chiefly covered by three polished black stripes, interspaces very narrow and obscured, especially behind scutum similarly polished black; scutellum pale yellow, parascutella infuscated; mediotergite black centrally, paling to obscure brownish yellow on sides; pleurotergite brownish yellow. Pleura pale yellow, episternum more darkened, especially on anepisternum, to form a weak transverse girdle, crossing dorsopleural region and lateral borders of præscutum to disc of latter. Halteres with stem yellow, knob dark brown. Legs with coxæ and trochanters pale yellow; femora yellow, tips rather narrowly but conspicuously blackened, the amount subequal on all legs; tibiæ brown, tips passing into brownish black; tarsi black; claws with a single long basal tooth. Wings (Plate 1, fig. 3) bicolored, basal two-thirds grayish subhyaline, distal portion strongly infuscated, including all cells beyond cord except those immediately surrounding the darker brown, oval stigma, which

are whitish; wing tip similarly narrowly and vaguely whitened; axilla and adjacent regions of arculus restrictedly darkened; veins dark brown. Squama apparently naked. Venation: Rs oblique, straight, a little shorter than R_{2+3}; cell M_1 deep; cell 1st M_2 hexagonal; m-cu at near two-thirds the length of M_{3+4}.

Abdominal tergites bicolored, yellow, caudal margins broadly dull black; second tergite with base similarly blackened; outer tergites, including ninth, uniformly black; sternites yellow, second and third with posterior borders black, fourth to seventh, inclusive, uniformly yellow; eighth sternite black, ninth yellow. Male hypopygium (Plate 2, fig. 26) with the tergite, 9*t*, distinct from the sternite, 9*s*. Tergite (Plate 2, fig. 27, 9*t*) profoundly split into two lobes, each with apex truncate, with coarse spines, margin roughened; from ventral face of tergite a longer plate forming two glabrous lobes, separated by a linear incision; lateral margins of lobes with a single series of black peglike spines; a long powerful spine on either side, these approximated at base to form a lyriform structure; a small curved fingerlike arm on side of plate near base, each tipped with a few short black spines. Dististyles, *d*, simple, the inner split nearly to base to form two separate lobes. Notch of ninth sternite with a small fleshy pale lobe on either side. Eighth sternite unarmed.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Tipula (*Schummelia*) *bicolorata* is very distinct from the other regional species so far described, differing especially in the polished black color of the mesonotum, the bicolored wings, and the structure of the male hypopygium. The squama appears to lack the conspicuous setæ found in other members of the subgenus *Schummelia*, but the assignment appears to be correct.

NEPHROTOMA PARVA (Edwards).

Pachyrrhina parva EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 266, 267.

Described from Mount Ari, Formosa, altitude 8,000 feet, collected October 10, 1912, by Nitobe. A few specimens of both sexes from Hong San, Kiangsi, southeastern China, altitude 3,000 to 3,400 feet, June 24 to 29, 1936 (*Gressitt*), and from Tsin Leong San, eastern Kwangtung, China, altitude 2,750 feet, June 4, 1936 (*Gressitt*).

Allotype.—Length, about 10 millimeters; wing, 8.5.

Agreeing closely with the male in size and color. Central portions of scutal lobes a trifle darker than the ground, but not blackened; scutellum faintly darkened. Wings with cell Sc darkened; stigma a trifle darker than the ground. Cell M_1 with very short petiole or sessile, the character variable. Median line of abdominal tergites weakly infumed.

Allotype, female, Hong San, Kiangsi, altitude 3,150 feet, June 27, 1936 (*Gressitt*).

NEPHROTOMA NIGROSTYLATA Alexander.

Nephrotoma nigrostylata ALEXANDER, Philip. Journ. Sci. 57 (1935) 204–206.

Hitherto known only from Szechwan, western China. Several specimens of both sexes, Foochow, Fukien, southeastern China, May 1, 1936 (*Kellogg*).

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) CITRIVENA sp. nov. Plate 1, fig. 4; Plate 2, fig. 28.

Thorax and abdomen uniformly orange; head brown; halteres yellow, outer half of knob black; femora yellow, tips broadly blackened; tibiæ and basal tarsal segments brownish yellow to yellow; wings pale yellow, veins deep orange-yellow throughout; Rs oblique; R_2 long, bending into R_{2+3} in an unusually long curve; anal veins convergent.

Male.—Length, about 11 millimeters; wing, 9.5.

Rostrum very small, brown; palpi reduced, black. Antennæ with scape brownish yellow, pedicel and flagellum black; flagellar segments subcylindrical to oval, with short apical necks; verticils nearly twice length of segments; terminal segment one and one-half length of penultimate, cylindrical. Holoptic or virtually so; head brown, posterior portion paler.

Thorax uniformly orange. Halteres yellow, outer half of knob black. Legs with coxæ and trochanters yellow; femora yellow, clearer at base, tips broadly blackened, the amount subequal on all legs, including about the distal sixth; tibiæ pale brownish yellow, tips narrowly and weakly darkened; tarsi with basal three segments yellow, outer segments dark. Wings (Plate 1, fig. 4) pale yellow, without stigma; cells C and Sc clearer yellow; veins deep orange-yellow. Macrotrichia on longitudinal veins beyond cord with exception of R_2. Venation: Sc long,

Sc_1 ending about opposite m-cu, Sc_2 at its tip; Rs oblique, vein R_1 beyond free tip of Sc_2 long, bending gently into R_{2+3}; cell 1st M_2 shorter than any veins beyond it, m-cu at near midlength; anal veins strongly convergent.

Abdomen, including hypopygium, uniformly deep orange. Male hypopygium (Plate 2, fig. 28) with tergite, 9*t*, slightly narrowed outwardly, apex truncated or virtually so. Ventral dististyle, *vd*, fleshy, in area nearly equal to basistyle; a fleshy pale lobe on face, terminating in two strong setæ; rostral prolongation relatively slender, with a group of rostral spines near base, these apparently four in number in a close group but difficult to count in the unique type. Gonapophyses, *g*, with mesal apical lobe slender, a low flange on margin before apex. Ædeagus, *a*, unusually broad, bifid at apex.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Limonia (*Libnotes*) *citrivena* is distinct in the uniform orange color of the body, in conjunction with the pale-yellow wings with orange veins.

LIMONIA (LIBNOTES) CROCEA CELESTIA subsp. nov.

Male.—Length, about 9 to 9.5 millimeters; wing, 10 to 11.

Characters as in typical *crocea* (Edwards)[5] of Siam, differing in the coloration of the thorax.

Anterior vertex reduced to a narrow strip, in width about one-fourth diameter of scape. Thorax uniformly orange, præscutum and scutum unmarked, surface shiny. Bases of fore femora a trifle brightened. Wings with arcular darkening not passing vein M behind. Male hypopygium with lobe of basistyle large. Dorsal dististyle a gently curved rod, tip decurved, surface of style with abundant delicate appressed setæ. Ventral dististyle relatively small, produced into a slender prolongation, the usual spines arising from base of prolongation, placed close together, their tips narrowed into hairlike points; from face of style near base of prolongation a strong tubercle tipped with a very long strong seta. Gonapophyses with mesal apical lobes slender, nearly straight, darkened.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Paratopotypes, 2 males.

[5] Ann. & Mag. Nat. Hist. VIII 17 (1916) 353.

Edwards [6] records this same race from two stations in lowland North Borneo.

LIMONIA (DICRANOMYIA) MESOSTERNATA (Alexander).

Dicranomyia mesosternata ALEXANDER, Ann. Ent. Soc. America 12 (1919) 329, 330.

Widespread in the Japanese Islands (Karafuto, Hokkaido, Honshiu). One male, Chengtu, Szechwan, western China, altitude 1,800 feet, May 6, 1936 (*Franck*). The three species, *Limonia* (*Dicranomyia*) *consimilis* (Zetterstedt), *L.* (*D.*) *mesosternata* (Alexander), and *L.* (*D.*) *mesosternatoides* (Alexander), are allied and are most readily told by differences in the structure of the male hypopygium, especially the ventral dististyles and gonapophyses.

LIMONIA (GERANOMYIA) TORTA sp. nov. Plate 1, fig. 5; Plate 2, fig. 29.

Rostrum relatively short, less than one-half length of body; mesonotal præscutum testaceous brown with two sublateral darker brown stripes, lateral margins brown; pleura pale yellow; femora obscure yellow with an ill-defined darker subterminal ring, tips narrowly yellow; wings faintly tinged with brown, costal portion more yellowish; an extensive pale-brown pattern, chiefly costal in distribution; dark areas at origin of Rs and fork of Sc widely separated; Sc long; costal fringe (male) long; male hypopygium with a single very powerful tubercle and spine at apex of rostral prolongation of ventral dististyle.

Male.—Length, excluding rostrum, about 5.5 millimeters; wing, 6.2; rostrum, about 2.

Female.—Length, excluding rostrum, about 6 millimeters; wing, 6.5; rostrum, about 2.

Rostrum relatively short, about equal in length to head and thorax combined, black throughout; palpi black. Antennæ black. Front and anterior vertex narrowly silvery, continued backward to occiput as a silvery median vitta, remainder of posterior vertex blackened.

Pronotum light brown, narrowly darkened laterally. Mesonotal præscutum with ground color pale testaceous brown, patterned with darker brown, including longitudinal narrow stripes occupying usual interspaces, extending entire length of præscutum; median dark vitta barely indicated; lateral borders of præscutum rather broadly darkened, in fresh specimens tinged

[6] Journ. Fed. Malay St. Mus. 16 (1931) 494.

with green; humeral region yellowish white, the color continued caudad between lateral darkened areas; scutal lobes weakly darkened, median region restrictedly pale; scutellum testaceous, parascutella a little darker; mediotergite brown. Pleura yellow, unmarked except for vague spots on dorsopleural membrane. Halteres dusky, stem more greenish. Legs with coxæ and trochanters testaceous yellow, with greenish tinges; femora obscure yellow, with an ill-defined dark subterminal ring, tips narrowly yellow; tibiæ and tarsi pale brown. Wings (Plate 1, fig. 5) with a faint brown tinge, ground color of costal region more yellowish; an extensive pale-brown pattern, including a series of about six costal areas, the second at the supernumerary crossvein in cell Sc, third at origin of Rs, fourth at fork of Sc, fifth stigmal, sixth at tip of vein R_3; in more heavily colored individuals areas two and three reaching vein M behind, in other specimens these areas more restricted; cord and outer end of cell 1st M_2 narrowly seamed with pale brown; very restricted pale-brown clouds at ends of veins Cu_1 and 2d A; veins brown, yellow in costal interspaces. Male with costal fringe long and conspicuous. Venation: Sc long, Sc_1 ending about opposite four-fifths to five-sixths length of Rs, Sc_2 at its tip; a supernumerary crossvein in cell Sc; cell 1st M_2 subequal in length to vein M_{1+2} beyond it; m-cu close to fork of M; cell 2d A moderately wide.

Abdominal tergites and hypopygium brown; sternites yellow. Male hypopygium (Plate 2, fig. 29) with tergite, 9*t*, rather deeply notched. Basistyle, *b*, with ventromesal lobe small, slightly and unequally bilobed. Dorsal dististyle a powerful curved hook. Ventral dististyle, *vd*, of moderate size, larger than basistyle; rostral prolongation very strong and powerful, close to apex with a very long tubercle that merges at near two-thirds length into a single powerful spine or two unequal, partially fused spines; combined spine and tubercle in length exceeding dorsal dististyle. Gonapophyses, *g*, with mesal apical lobe slender, curved.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude, 4,000 feet, May, 1936 (*Sircar*). Allotopotype, female. Paratopotype, female.

Limonia (*Geranomyia*) *torta* is very different from the other regional species of the subgenus in the short rostrum, the pattern of the præscutum and pleura, wing pattern, long costal fringe in male, and in the structure of the male hypopygium. The costal fringe is somewhat as in the otherwise entirely distinct *L.* (*G.*) *longifimbriata* Alexander (Philippines). The

structure of the male hypopygium is most similar to that of *L.* (*G.*) *baliana* Alexander (Bali) which has the costal fringe short and all details of coloration and venation distinct.

LIMONIA (GERANOMYIA) FUMIMARGINATA VACIVA subsp. nov.

Female.—Length, excluding rostrum, about 6.3 to 6.7 millimeters; wing, 6.5 to 7; rostrum, about 2.2 to 2.4.

Close to the typical form, distinguished especially by the subterminal, slightly darkened femoral ring and the more heavily patterned wings. Antennal flagellum pale brown, much paler than basal segments. Præscutal stripes brownish black, median stripe widest opposite pseudosutural foveæ. Femora with an ill-defined pale-brown subterminal ring, tips clear yellow. Wings with the pattern quite distinct from that of the typical form; dark costal areas with the pale centers much more restricted, the dark margins correspondingly widened; dots and marbling of basal field more abundant and irregular, invading cells C and Sc and interpolating darkenings between first and second (h and supernumerary crossvein in cell Sc) and second and third (origin of Rs) major costal areas.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Paratopotype, female.

HELIUS (HELIUS) PAVONINUS sp. nov. Plate 1, fig. 6; Plate 2, fig. 30.

General coloration black; halteres yellow; legs yellow, tips of femora conspicuously black; wings brown, patterned with large, pale cream-colored areas, including two major spots just beyond one-third length of wing, constricting ground color at this point; other pale areas beyond cord.

Male.—Length, about 6 millimeters; wing, 6 to 6.5.

Female.—Length, about 6.5 to 7 millimeters; wing, 6 to 6.5.

Rostrum black, slightly longer than remainder of head; palpi black. Antennæ short, about one and one-half length of rostrum; scape black, pedicel brownish black, flagellum brown; basal flagellar segments oval, terminal segment elongate; verticils about equal in length to segments. Head brownish black, front and orbits more grayish; anterior vertex narrow.

Pronotum brownish black. Mesonotal præscutum reddish brown, with three blackish stripes, median stripe long and complete, lateral stripes short and inconspicuous; lateral margins of præscutum blackened; posterior sclerites of notum brownish black. Pleura black. Halteres with stem pale or weakly in-

fumed, extreme base and knob clear yellow. Legs with the coxæ brownish black, fore pair a little brightened at tip; trochanters yellow, posterior pair more darkened; femora light yellow, tips conspicuously (0.6 to 0.7 millimeters, or about distal eighth or ninth) and abruptly black; tibiæ and tarsi yellow, terminal segments darker; claws simple. Wings (Plate 1, fig. 6) with a strong brown suffusion, handsomely patterned with pale cream-yellow, as follows: Major areas in cell R before origin of Rs and opposite this in outer ends of cells Cu and 1st A, restricting dark ground color at this level to cell M; a nearly complete but narrow pale band beyond cord, including broad bases of outer radial cells, center of cell 1st M_2, and outer end of cell M_4; isolated smaller yellow areas before stigma in cell R_1 and beyond tip of vein R_3 in cell R_3; anterior prearcular region, with cells C and Sc clear yellow; veins brown, yellow in clear areas. Anterior branch of Rs with a variable number of macrotrichia, in cases these lacking; other branches of R and M, with the exception of M_4, with trichia. Venation: Sc relatively long, Sc_1 ending shortly before fork of Rs, Sc_2 near its tip; branches of Rs strongly divergent, cell R_3 at margin thus very wide; m-cu at near one-third to one-half length of cell 1st M_2.

Abdomen black, hypopygium a little more reddish brown. Male hypopygium (Plate 2, fig. 30) with outer dististyle, *od*, relatively stout, outer tooth bearing a tiny lateral spinule before apex; inner tooth elongate. Lateral tergal lobes, 9*t*, appearing as unusually large expanded blades.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Allotopotype, female, pinned with type. Paratopotypes, 7 of both sexes.

Helius (*Helius*) *pavoninus* is entirely different from all other described species of the genus, especially in the handsomely patterned wings.

HELIUS (HELIUS) CTENONYCHA sp. nov. Plate 1, fig. 7; Plate 2, fig. 31.

General coloration of præscutum obscure yellow, with a narrow but conspicuous dark-brown median stripe; head dark gray; antennæ relatively short; legs black, tarsi paling to yellow; claws conspicuously toothed; wings strongly infumed, costal border broadly darker brown to wing apex; Sc_1 ending nearly opposite r-m; cells R_2 and R_3 at wing margin subequal in extent; cell

1st M_2 rectangular, one and one-half as long as wide; m-cu at or very close to fork of M; male hypopygium with outer dististyle bearing a straight lateral spine some distance before tip; lateral lobes of tergite appearing as very flattened blades with obtusely rounded tips.

Male.—Length, about 6 millimeters; wing, 6 to 6.5.

Female.—Length, about 7 millimeters; wing, 6.2 to 6.8.

Rostrum black, about equal in length to remainder of head; palpi black. Antennæ about as long as head, including rostrum; scape and flagellum black, pedicel more brownish; flagellar segments oval, beyond fifth or sixth becoming more elongate. Head dark gray, with conspicuous erect to proclinate black setæ.

Cervical sclerites black. Pronotum and præscutum obscure yellow, narrowly but conspicuously dark brown medially; posterior sclerites of notum more uniformly dark brown. Pleura yellow, mesepisternum in cases weakly darkened. Halteres dark brown, base of stem restrictedly yellow. Legs with coxæ and trochanters yellow; femora black, bases very narrowly obscure yellow, more evident on forelegs; tibiæ and basitarsi black, outer tarsal segments paling to yellow; claws large, yellow, each with three long conspicuous teeth, outer tooth largest. Wings (Plate 1, fig. 7) strongly infumed, broad costal margin to wing tip still darker brown, stigma not further differentiated; veins dark brown. Costal fringe short. Venation: Sc relatively long, Sc_1 ending nearly opposite r-m, Sc_2 a short distance from its tip; branches of Rs very gradually diverging from one another; cells R_2 and R_3 at margin subequal; cell 1st M_2 rectangular, one and one-half as long as wide; m-cu at or very close to fork of M.

Abdominal tergites brown, caudal borders a little darker; basal sternites obscure brownish yellow, darker laterally; subterminal segments dark brown; hypopygium a little brightened. Male hypopygium (Plate 2, fig. 31) with the basistyle, *b*, simple, with more abundant setæ on mesal face than on outer. Outer dististyle, *od*, shorter than inner, sickle-shaped, with a conspicuous lateral spine some distance from tip. Inner dististyle, *id*, with distal half unusually long and slender. Lateral lobes of tergite, 9*t*, appearing as very flattened blades, tips oval.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female. Paratopotypes, 1 male, 1 female. Paratypes, 6 males, Batan bessi, Sangkoelirang district, May, 1937 (*Walsh*).

The most similar species is *Helius* (*Helius*) *fumicosta* Edwards (Malay Peninsula) which differs in the shorter rostrum, in the shortened basal flagellar segments, in the uniformly reddish brown thorax, and in the venational details, as the short cell 1st M_2, with m-cu shortly beyond its base. The long teeth on the claws in the present species are very conspicuous.

HELIUS (HELIUS) NIGRICAPELLA sp. nov. Plate 1, fig. 8; Plate 2, fig. 32.

Allied to *nigriceps;* general coloration of mesonotum almost uniformly dark brown; antennæ short, flagellum brown; pleura yellowish brown, blackened dorsally; wings grayish, cells C and Sc with stigma more infuscated; Sc_1 ending shortly before fork of Rs; m-cu about one-fourth its length before fork of M; male hypopygium with outer dististyle terminating in two very short points; inner dististyle with apical portion broad; lateral lobes of tergite with a narrow head, margin produced into a single acute recurved point.

Male.—Length, about 6 millimeters; wing, 5.5; antennæ, 1.

Rostrum and palpi black, the former subequal in length to remainder of head. Antennæ relatively short; scape and pedicel black, flagellum brown; basal flagellar segments oval, outer segments more elongate; basal flagellar segment with conspicuous basal pedicel, succeeding segments with this much shorter; terminal segment one and one-fourth as long as penultimate; verticils shorter than segments, unilaterally distributed. Head black; anterior vertex reduced to a narrow strip.

Mesonotum almost uniformly dark brown. Pleura with dorsal portion occupied by a blackened stripe that also includes the pleurotergite; ventral pleurites paler, yellowish brown. Halteres black. Legs with coxæ and trochanters obscure yellow; femora black, bases of fore pair restrictedly paler; tibiæ and basitarsi black, outer tarsal segments paler; claws with basal spines. Wings (Plate 1, fig. 8) grayish, cells C and Sc, with the stigma, more infuscated; margin of outer radial field slightly darkened; veins brown. Costal fringe (male) moderately long. Venation: Sc relatively long, Sc_1 ending shortly before fork of Rs, Sc_2 close to its tip; branches of Rs gently divergent, cell R_2 at margin very narrow, about one-fifth that of cell R_3; cell 1st M_2 small, irregularly pentagonal, much shorter than any of veins beyond it; m-cu about one-fourth its length before fork of M; cell 2d A relatively wide.

Abdomen black, hypopygium a little brightened. Male hypopygium (Plate 2, fig. 32) with mesal face of basistyle, *b*, with

abundant coarse setæ but otherwise unarmed. Outer dististyle, *od*, relatively short, gently curved, at apex split into two very short cultriform points. Inner dististyle, *id*, longer, distal third more flattened, only slightly narrower than base. Lateral lobes of tergite, 9*t*, with expanded apex unusually narrow, margin produced into a single acute recurved point.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Helius (*Helius*) *nigricapella* is closely allied to *H.* (*H.*) *nigriceps* Edwards. I possess a paratype of this latter species through the friendly interest of Doctor Edwards; the species differs in the venation, especially the wider radial field and more divergent branches of Rs, although cell R_2 at margin is similarly very narrow. What I have determined as *nigriceps* from Sumatra differs further in the simple claws and in the structure of the male hypopygium, especially in the narrow apex of the inner dististyle and the entirely different conformation of the apices of the lateral tergal lobes.

HEXATOMINI

GYNOPLISTIA (GYNOPLISTIA) ALBIZONATA sp. nov. Plate 1, fig. 9.

Entire thorax pale orange yellow, opaque; head black; halteres yellow; legs black, all tibiæ with a narrow white ring at near basal third; wings blackish, prearcular region abruptly clear yellow; veins of outer radial field with abundant macrotrichia; cell M_1 present; abdomen with segment one and basal ring of segment two yellow, remaining segments blackened basally, caudal margins gray; subterminal segments and genital shield black.

Female.—Length, about 15 millimeters; wing, 13.

Rostrum and palpi black. Antennæ 17-segmented, black throughout; formula (female) 2+3+4+8; branch of first flagellar segment short and obtuse; second branch about twice the segment; longest branch (about flagellar segment three or four) about two and one-half times the segment; penultimate segment indistinctly separated from terminal. Head transverse, black.

Entire thorax pale orange-yellow, surface opaque. Halteres yellow. Legs with coxæ and trochanters orange; femora black, extreme bases of fore pair yellow, this color even more reduced on remaining femora; tibiæ black with a narrow white ring at near basal third, narrowest (about 0.5 to 0.6 millimeter) on forelegs, widest (about 1.1 to 1.2 millimeters) on posterior

legs; vestiture of annuli similarly whitened; tarsi black. Wings (Plate 1, fig. 9) relatively broad, deeply suffused with black, more saturated in costal portion; wing base to level of arculus bright yellow, clearly delimited; veins dark brown, yellow in prearcular field. Macrotrichia of outer radial veins abundant, fewer and more scattered on veins M_1 and M_2, lacking on M_3 and M_4. Venation: Sc_2 projecting beyond level of Sc_1, ending shortly beyond level of origin of R_{2+3}; R_{2+3+4} short, subequal to or shorter than R_2; petiole of cell M_1 about two-thirds the cell; m-cu at near midlength of cell 1st M_2.

Abdomen with segment one and basal ring of segment two clear yellow; remainder of tergite two and succeeding tergites blackened basally, caudal margins broadly blue-gray, on the subterminal segments more uniformly blackened; sternites chiefly blackened, caudal margins of segments narrowly gray; shield of ovipositor dull black; cerci stout, flattened-compressed, black, tips horn-yellow; hypovalvæ uniformly blackened.

Habitat.—New Guinea (Morobe District).

Holotype, female, Mount Misim, altitude 6,400 feet, March (*Stevens*); Museum of Comparative Zoölogy, Cambridge, Massachusetts, through Dr. Nathan Banks.

Gynoplistia (*Gynoplistia*) *albizonata* is very different from other species of the genus in the Papuan fauna. *G.* (*G.*) *insolita* Walker, of Salwatty, has somewhat similar white rings on the tibiæ but is entirely different in other respects.

HEXATOMA (ERIOCERA) PERORNATA sp. nov. Plate 1, fig. 10.

Allied to *lunata;* general coloration ochreous and dark brown; antennæ (male) greatly elongated, approximately four times length of body; wings grayish subhyaline, conspicuously patterned with brown and yellow, latter color appearing as seams to certain veins; cell R very wide at outer end; cell M_1 present; m-cu at fork of M; abdominal segments yellow, intermediate tergites with caudal borders narrowly blackened.

Male.—Length, 11 to 12 millimeters; wing, 12.5 to 13.5; antennæ, about 45.

Rostrum greatly reduced in size, pale brown; palpi black, porrect. Antennæ (male) greatly elongated, approximately four times length of body, as shown by measurements; scape enlarged, obscure yellow, streaked above with a dusky line; pedicel yellow, darkened beneath; flagellum brownish black to black, segment one restrictedly paler at base; all flagellar segments with a uni-

laterally arranged series of outwardly directed spines, more numerous on basal segments, becoming sparse and scattered on outer segments. Vertical tubercle unusually large and inflated, obscure yellow, with dense long pale hairs; antennal fossa involving anterior face of tubercle; posterior portion of head ochreous yellow.

Mesonotal præscutum variegated with ochreous and dark brown, the pattern consisting of two brown stripes on anterior half, their outer margins thence directed laterad and forming outer borders of usual præscutal stripes, median region behind thus chiefly pale, slightly more infumed before suture; scutum grayish ochreous, lobes variegated with brown; scutellum light gray, parascutella darker; postnotum pale ochreous. Mesonotum with long, coarse, chiefly pale-brown hairs, longest and most conspicuous on præscutum, involving stripes as well as interspaces. Pleura chiefly pale, variegated with brown on anepisternum and sternopleurite. Halteres yellow, small knobs darkened. Legs with coxæ darkened; trochanters reddish brown; remainder of legs yellow, tips of tibiæ and outer tarsal segments darkened; legs relatively short and stout, conspicuously hairy; claws with basal spine. Wings (Plate 1, fig. 10) with ground color grayish subhyaline, conspicuously patterned with brown and yellow, somewhat as in *ornata;* brown pattern including prearcular field, bases of cells R and M, anterior border of cell R, virtually all of R_1, and basal half of R_4; cells C, Sc, Sc_1, R_2, and R_3 brown, with conspicuous whitish streaks; a dark-brown seam continued along vein R_5 to margin; cord and adjoining portions of veins M, M_{1+2}, and m conspicuously bordered by yellow, this, in turn, similarly margined with brown; tips of veins R_{1+2}, R_3, and R_4 similarly bordered by yellow, like basal half of vein M where it traverses the darkened basal cells; anal cells more infuscated, especially in the axilla and as a seam on outer half of vein 2d A. Costal fringe short but abundant; veins beyond cord virtually glabrous; a scattered series of small trichia for almost the entire length of outer section of vein R_5. Venation: Much as in *ornata* and *lunata;* Rs very long, on basal third paralleling vein R_1, thence very gradually diverging, but cell R_1 unusually narrow at outer end; vein M arched at midlength; cell R at outer end of unusual width, as in *ornata* and *lunata;* cell M_1 present; vein m very long, oblique; basal section of M_{1+2} long and strongly arcuated, inner end of

cell 1st M_2, thus lying proximad of other elements of cord; m-cu at fork of M, shorter than distal section of Cu_1; cell 2d A wide.

Abdomen short and arcuate, as common in males of this genus having elongate antennæ; segments yellow, intermediate tergites narrowly and inconspicuously bordered with black, most evident on posterior margin of tergite two; outer segments and hypopygium more uniformly infuscated; basal tergites whitish pruinose, narrowly darkened medially; abdomen with long setæ, most conspicuous on sides and toward outer end.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in unending swampy forest, May, 1937 (*Walsh*). Paratopotype, 1 male.

This fly and the species next described as *Hexatoma* (*Eriocera*) *perlunata* sp. nov. are unquestionably most nearly allied to *H.* (*E.*) *lunata* (Westwood) and *H.* (*E.*) *ornata* (Enderlein), despite the possession of cell M_1. The four species form a very isolated group, with a distribution ranging from the Malay Peninsula and Sumatra to Borneo. All are well-distinguished by the greatly elongated antennæ of the male and by certain venational features, as the position of Rs, which on its basal portion lies parallel to vein R_1, and by the unusual width of cell R at its outer end. Edwards[7] has well discussed the interrelationships existing between *lunata* and *ornata*.

HEXATOMA (ERIOCERA) PERLUNATA sp. nov. Plate 1, fig. 11.

Female.—Length, about 13 millimeters; wing, 10; antennæ, about 2.

Closely allied to *perornata* sp. nov., but differing in virtually every detail of color.

Rostrum brown; palpi black. Antennæ 7-segmented, very short; scape pale, pedicel and flagellar segments gradually smaller outwardly, last subglobular. Vertical tubercle moderately enlarged, deep chestnut-brown; head darker behind.

Thorax almost uniformly dull black; setæ short and sparse. Halteres black throughout. Legs with coxæ and trochanters black; fore femora yellow with about distal fourth brownish black; remaining femora almost uniformly infuscated, tips a little more blackened; tibiæ black, extreme bases narrowly orange; tarsi black; claws simple. Wings (Plate 1, fig. 11) with

[7] Ann. & Mag. Nat. Hist. IX 8 (1921) 68, 70, 71, 93, 94.

the restricted ground color whitish subhyaline, remainder chiefly dark brown, including all of wing before cord except anal cells, a lunule of the ground color in cells R and M before cord, and very restricted yellow spots, as follows: h, origin of Rs, fork of Sc, cord, and tips of veins R_{1+2}, R_3, and R_4; beyond cord, the whitish ground involving the broad outer ends of cells R_4 to M_4, inclusive, interrupted by a broad dark seam along vein R_5 to margin or nearly so; cell Cu dark except for a pale spot nearly at outer end; cell 1st A chiefly brownish gray; cell 2d A darkened, with an obscure yellow spot before midlength, crossing vein 2d A into cell 1st A. Venation: Almost as in *perornata*.

Abdomen black, vaguely brightened by obscure yellow areas on intermediate tergites. Cerci long and slender, horn-yellow.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Paratopotype, female.

Despite the entirely differing general appearance, the present fly is very closely related to *Hexatoma* (*Eriocera*) *perornata* sp. nov., and the possibility is not excluded that the two names represent the sexes of a single species. If such should prove to be the case, the sexual dichroism would be extreme for species within the genus.

HEXATOMA (ERIOCERA) NIMBIPENNIS sp. nov. Plate 1, fig. 12.

Belongs to the *verticalis* group; general coloration brownish black to black; antennæ (male) elongate, approximately four times length of body; scape and pedicel chestnut yellow, flagellum black; flagellar segments with numerous erect spines; vertical tubercle black; præscutum without stripes; halteres brownish black throughout; femora yellow, base and apex darkened; wings with a strong brownish tinge; stigma oval, darker brown; macrotrichia on veins beyond cord sparse or lacking; veins R_{1+2}, R_2, and R_{2+3} subequal; R_{1+2} in longitudinal alignment with R_1; m-cu at fork of M; abdomen and hypopygium dull black.

Male.—Length, about 11 millimeters; wing, 13; antennæ, about 45; flagellar segment one, 12; flagellar segment two, 13.

Rostrum short, black; palpi black. Antennæ (male) very long, approximately four times length of body; scape and pedicel chestnut yellow, flagellum black; flagellar segments with numerous erect spines, becoming more sparse and scattered on outer segments. Head brownish black; vertical tubercle very large and bulbous, with conspicuous erect pale setæ.

Mesonotum brownish black to dull black, præscutum without evident stripes; interspaces with long erect white setæ. Pleura dull black, very sparsely pruinose. Halteres brownish black throughout. Legs with coxæ and trochanters brownish black; femora yellow, base and apex darkened; tibiæ dark brown; tarsi black; claws with tooth at extreme base. Wings (Plate 1, fig. 12) with a strong brown tinge, cell Sc a little more yellowish; stigma oval, darker brown than the ground; veins brown, Sc, Cu, and veins near wing base more yellowish; vein C more incrassated opposite stigmal region. Costal macrotrichia short but abundant; trichia lacking on veins beyond cord, with exception of a restricted series on distal section of vein R_5. Venation: R_{1+2}, R_2, and R_{2+3} all short, subequal in length; R_{1+2} straight, in virtual longitudinal alignment with R_1, not upcurved to costa, as common in the group; Rs about three times R_{2+3+4}; m-cu at fork of M.

Abdomen, including hypopygium, dull black.

Habitat.—Western Java.

Holotype, male, Tjikarang, Djampangs, November, 1936 (*Walsh*).

Hexatoma (*Eriocera*) *nimbipennis* is allied to *H.* (*E.*) *verticalis* (Wiedemann), differing especially in the almost uniform black color of the body and halteres, with no præscutum stripes.

HEXATOMA (ERIOCERA) NIMBIPENNIS STYGIPES subsp. nov.

Female.—Length, about 15 millimeters; wing, 12.

Similar to the typical form, differing as follows: Antennæ and legs entirely and uniformly black. Wings more uniformly blackened, costal region and seams along radial veins darker; stigma scarcely differentiated against the ground.

Habitat.—Western Java.

Holotype, female, Bibidjilan, Djampangs, November, 1936 (*Walsh*).

HEXATOMA (ERIOCERA) ENAVATA sp. nov. Plate 1, fig. 13.

Belongs to the *verticalis* group; general coloration brown; antennæ (female) 10-segmented, scape and pedicel yellow, flagellum black; wings with a weak brown tinge; stigma pale brown; macrotrichia of veins beyond cord reduced in number; R_3 short, about two-thirds as long as R_{2+3+4}; cell 1st M_2 about equal in length to vein M_{1+2} beyond it; valves of ovipositor elongate.

Female.—Length, about 9 millimeters; wing, 7.5.

Rostrum very reduced, testaceous; palpi short, brown. Antennæ (female) 10-segmented; scape and pedicel yellow, flagellum black; basal flagellar segment much more incrassated than those following, especially on basal half; flagellar segments two and three subequal in length; succeeding segments gradually decreasing in length. Head brown; vertical tubercle inconspicuous.

Mesonotum almost uniformly dark brown, posterior sclerites more pruinose; setæ of præscutum almost lacking, reduced to a few microscopic ones near suture. Pleura dark brown, sparsely pruinose. Halteres infuscated. Legs with coxæ and trochanters brown; femora obscure yellow to brownish yellow, tips weakly darkened; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 13) with a weak brown tinge; stigma oval, pale brown; veins brown, C and Sc more yellowish. Macrotrichia of veins beyond cord virtually confined to a complete series on vein R_5. Venation: Sc_1 ending about opposite r-m, Sc_2 a short distance from tip; Rs long, about twice R_{2+3+4}; R_2 a little longer than R_{1+2}, placed before the fork, so a short element R_{3+4} is present; R_3 about two-thirds as long as R_{2+3+4}; cell 1st M_2 about equal in length to vein M_{1+2} beyond it; m reduced; m-cu close to fork of M, longer than distal section of Cu_1.

Abdominal tergites dark brown; basal sternites a little brightened; genital shield yellow. Ovipositor with valves long and slender, dark brown.

Habitat.—Western Java.

Holotype, female, Tjimerang, Djampangs, October, 1936 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera* [8] the present fly runs to *Hexatoma* (*Eriocera*) *pusilla* Alexander, of Tropical Africa, which somewhat resembles the present species in general appearance but differs fundamentally in the short fleshy valves of the ovipositor. Whether the antennæ of the male sex of the present insect are elongate remains a questionable point, but from the reduced vertical tubercle of the female it seems very possible that this is not the case.

HEXATOMA (ERIOCERA) RUFICAUDA (Edwards).

Eriocera ruficauda EDWARDS, Journ. Fed. Malay St. Mus. 16 (1931) 502, 503.

The unique type was taken from Bettotan, at low altitudes in British North Borneo. A female from Pelawau berar,

[8] Ann. & Mag. Nat. Hist. IX 8 (1921) 70–78.

Sangkoelirang district, East Borneo, taken May, 1937, by Mrs. Walsh, is very similar to the type, differing in minor regards only.

Antennæ (female) 11-segmented; basal segments obscure yellow, outer segments more darkened; antennæ shorter than combined head and thorax. Trochanters and femoral bases pale. Venation: R_{2+3} one and one-half as long as R_{2+3+4} and fully four times R_2 alone; petiole of cell M_1 about twice the cell.

HEXATOMA (ERIOCERA) AZUREA sp. nov. Plate 1, fig. 14.

General coloration velvety black; legs black, femora broadly bright yellow on basal portions; wings black, prearcular field abruptly yellow; Rs relatively short, less than R; m-cu at outer end of cell 1st M_2; abdomen velvety black with conspicuous deep blue shiny rings on tergites two to six, inclusive; genital shield black.

Female.—Length, about 18 millimeters; wing, 15.5.

Rostrum and palpi black. Antennæ with scape and pedicel black; flagellum broken. Head black, sparsely dusted with gray; vertical tubercle low, entire.

Thorax uniformly velvety black; vestiture of præscutum moderately long but sparse. Halteres uniformly dark brown. Legs with coxæ and trochanters brownish black; femora bright yellow on basal third to half, remainder of legs uniformly black. Wings (Plate 1, fig. 14) black, prearcular field abruptly and conspicuously light yellow; paler longitudinal streaks in cells R, M, and 1st A; veins brown, yellow in prearcular field. Macrotrichia of outer radial veins relatively abundant except at ends of veins; no trichia on outer medial branches. Venation: Rs relatively short, less than twice basal section of R_5 and shorter than R; R_{2+3+4} shorter than basal section of R_5; R_{1+2} long, one and one-half as long as either R_{2+3+4} or R_{2+3}; cell M_1 lacking; m-cu at outer end of cell 1st M_2, shorter than distal section of Cu_1.

Abdomen velvety black, with deep blue shiny rings at midlength of tergite two and on bases of tergites three to six, inclusive; genital shield black; cerci elongate, very gently upcurved, horn-colored.

Habitat.—Mindanao.

Holotype, female, Zamboanga; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through gift of B. P. Clark.

Hexatoma (*Eriocera*) *azurea* is most nearly allied to *H.* (*E.*) *chalybeicincta* (Alexander), likewise from Mindanao, differing

especially in the brightened femoral bases, yellow wing base, unusually short Rs, and long R_{1+2}. The brevity of Rs approaches the condition found in *H.* (*E.*) *selene* (Osten Sacken); in all other respects the present species is a very different fly.

HEXATOMA (ERIOCERA) VIRIDIVITTATA sp. nov.

General coloration of thorax dull black, præscutum with three polished metallic green stripes; antennæ with basal flagellar segments yellow; femora yellow, tips broadly black, tibiæ dark brown throughout; wings dark brown, prearcular region pale yellow, discal area whitish; genital shield orange.

Female.—Length, about 18 millimeters; wing, 14.

Rostrum and palpi black. Antennæ (female) 9-segmented; scape and pedicel dark brown; basal four flagellar segments yellow, terminal three segments dark brown; flagellar segments gradually decreasing in length, first about one and one-half times length of second; terminal segment one and one-half times length of penultimate. Head dull black, sparsely pruinose, with black setæ; vertical tubercle low.

Pronotum black. Mesonotal præscutum dull black with three broad polished metallic green stripes, interspaces narrowed behind; setæ of interspaces relatively sparse but long; posterior sclerites of notum brownish black, centers of scutal lobes more greenish. Pleura dull black. Halteres brownish black. Legs with coxæ and trochanters black; femora light yellow, tips conspicuously blackened, on fore and middle legs including distal third; posterior legs broken; tibiæ dark brown; tarsi black. Wings strongly infumed, prearcular region broadly light yellow; a more whitish discal blotch in cells R_1, R, and M; most cells of wing with somewhat paler central streaks to produce a slightly streaked appearance; veins stout, much more so than in *glabrivittata,* brown, yellow in pale areas. Outer radial branches with macrotrichia. Venation: Rs relatively long, about one and one-half as long as R; R_{1+2} subequal to R_{2+3}; R_{2+3+4} shorter than basal section of R_5; R_2 vertical; cell 1st M_2 relatively small, shorter than any of veins beyond it; cell M_1 lacking; m-cu at near midlength of cell 1st M_2, about one and one-half times length of distal section of Cu_1.

Abdomen with first tergite velvety black; tergites two to seven almost entirely nacreous brown, with bluish reflections, caudal borders of segments narrowly darkened, opaque; sternites more reddish brown; genital shield orange; cerci elongate, slender, dark brown on basal half, distal ends yellow.

Habitat.—Mindanao.

Holotype, female, Zamboanga; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through gift of B. P. Clark.

Closest to *Hexatoma* (*Eriocera*) *glabrivittata* Alexander (northern Luzon), differing in the metallic green præscutal stripes, orange genital shield, stout wing veins, and details of venation, as the longer and narrower cell 1st M_2.

HEXATOMA (ERIOCERA) DISJUNCTA sp. nov. Plate 1, fig. 15.

General coloration black, thorax dull black; antennæ (female) 8-segmented, flagellar segments yellowish brown; terminal segment about two-thirds penultimate; setæ of præscutal interspaces relatively inconspicuous; halteres and legs black; wings strongly tinged with blackish, cell 1st A paler; two disconnected white areas before cord, one in outer end of cell R_1, second crossing outer ends of cells R and M; wing tip narrowly yellow; veins R_{1+2} and R_{2+3+4} subequal; abdomen black, tergites subnitidous, with narrow velvety black posterior borders that become even narrower and finally evanescent on outer segments; eighth and succeeding abdominal segments orange.

Female.—Length, about 13 millimeters; wing, 10.

Rostrum and palpi black. Antennæ (female) 8-segmented; scape and pedicel black, outer flagellar segments more yellowish brown; flagellar segments gradually decreasing in length, last about two-thirds penultimate. Head dull black.

Mesonotum uniformly dull black; setæ of interspaces very short on cephalic half of præscutum, longer but still relatively inconspicuous behind. Pleura black. Halteres black throughout. Legs entirely black. Wings (Plate 1, fig. 15) with a strong blackish tinge, cell 1st A much paler, more grayish; prearcular region, base of cell C, and cell 2d A somewhat paler than ground; two entirely disconnected white discal spots of moderate size, one in outer end of cell R_1, the other occupying both cells R and M across distal end of vein M; wing tip narrowly but conspicuously pale yellow, extending from cell R_2 to 2d M_2; veins dark brown. Longitudinal veins beyond cord with abundant macrotrichia. Venation: Sc_1 ending opposite r-m; R_{1+2} relatively long, subequal to R_{2+3+4}, and approximately two and one-half to three times R_{2+3}; cell M_1 lacking; inner end of cell 1st M_2 strongly arcuated; m-cu at near four-fifths length of cell 1st M_2; distal section of Cu_1 rather strongly curved to margin but in longitudinal alignment with basal section.

Abdomen black, eighth and succeeding segments (female), including genital shield and valves of ovipositor, orange; tergites subnitidous, caudal margins of segments narrowly more velvety black, on intermediate segments including distal fourth or fifth of exposed portions of segments, becoming narrower on outer segments, segments five to seven almost entirely subnitidous.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swamp forest, May, 1937 (*Walsh*).

By Edwards's key to the Old World species of *Eriocera*[9] the present fly runs to *Hexatoma* (*Eriocera*) *leucotela* (Walker) of Singapore, disagreeing in the wing pattern and venational details. Edwards's figure of the type specimen of *leucotela*,[10] compared to the present fly, shows a single pale discal area, a much wider whitened apex, and both anal cells paler than the ground.

HEXATOMA (ERIOCERA) JUXTA sp. nov. Plate 1, fig. 16.

Allied to *disjuncta;* general coloration dull black; antennæ 8-segmented in both sexes; halteres and legs black; wings strongly suffused with blackish; a single white discal area, extending from cell R_1 into cell M; wing tip narrowly yellow; macrotrichia of veins of outer medial field sparse; abdomen polished black, broad posterior borders of segments velvety black, involving distal half to third of segments; genital shield of female black.

Male.—Length, 10 to 10.5 millimeters; wing, 8 to 8.5.

Female.—Length, 16 to 17 millimeters; wing, 11 to 12.5.

Rostrum and palpi black. Antennæ black throughout, 8-segmented in both sexes; terminal segment subequal to or a little longer than penultimate. Head black, gray pruinose.

Thorax uniformly black; setæ of præscutal interspaces relatively short and inconspicuous. Halteres and legs black. Wings (Plate 1, fig. 16) strongly suffused with blackish, cell 1st A paler; in female, axillary portion of cell 2d A similarly pale; a single white discal area, extending from cell R_1 into cell M, almost reaching vein Cu behind; wing tip narrowly yellow, involving cells R_3 to R_5, inclusive; veins brown, paler in the brightened apical lunule. Numerous macrotrichia in outer radial field, in outer medial field more sparse and restricted to extreme outer portions of veins, especially on M_{1+2}. Venation: R_{1+2} subequal to or longer than R_{2+3+4}; m-cu at from two-thirds to four-fifths

[9] Loc. cit. [10] Loc. cit., pl. 10, fig. 10.

length of cell 1st M_2; distal section of Cu_1 deflected caudad, not in longitudinal alignment with basal section.

Abdomen black, basal half or more of each tergite polished nacreous, the broad posterior borders more velvety black, involving distal half to third, narrowest on posterior segments; hypopygium and genital segments in female black; cerci horn yellow, elongate, nearly straight.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female. Paratopotypes, 1 male, 1 female.

Hexatoma (*Eriocera*) *juxta* is closely related to *H.* (*E.*) *disjuncta* sp. nov., both species running to the same place by the use of Edwards's key to the Old World species of the subgenus.[11] The present fly differs most evidently in the nature of the wing pattern, the restricted macrotrichia of the outer medial field, the much wider opaque black margins on the abdominal tergites, and the blackened genital shield of the female.

HEXATOMA (ERIOCERA) NEPALENSIS (Westwood).

Caloptera nepalensis WESTWOOD, Ann. Soc. Ent. France 4 (1835) 681.

Widely distributed in the Himalayan region, but hitherto I had seen no materials from eastern China. Males and females, Yim-Na-San, eastern Kwangtung, altitude 1,800 to 2,750 feet, June 11 to 15, 1936 (*Gressitt*).

ELEPHANTOMYIA INULTA sp. nov. Plate 1, fig. 17; Plate 3, fig. 33.

General coloration gray, præscutum with three conspicuous brown stripes; rostrum and antennæ black, the former nearly as long as body; pleura gray, variegated with darker; legs dark brown, tarsi a little paler; wings tinged with grayish, stigma scarcely darker; anterior branch of Rs nearly perpendicular at origin, gently arcuated along posterior border of stigma; branches of Rs strongly divergent, cell R_3 at margin very wide; cell 1st M_2 large; abdominal segments more or less bicolored; hypopygium light yellow.

Male.—Length, excluding rostrum, 4.5 to 5 millimeters; wing, 5.5 to 6.5; rostrum, 4 to 4.5.

Rostrum approximately as long as body (in male), black throughout. Antennæ black, scape and pedicel more or less pruinose; verticils of outer segments moderately long. Head dark gray; anterior vertex nearly three times diameter of scape.

[11] Loc. cit.

Pronotum gray. Mesonotal præscutum gray with three conspicuous brown stripes; scutal lobes dark brown, median area pale; scutellum broad, dark brown; mediotergite paler brown. Pleura gray, variegated with dark brown on anepisternum and ventral sternopleurite. Halteres pale, knobs very weakly darkened to obscure yellow. Legs with coxæ dark; trochanters brownish black; remainder of legs dark brown, tarsi paling to obscure yellow. Wings (Plate 1, fig. 17) tinged with grayish, stigma scarcely darker; veins pale brown. Sparse trichia on anterior branch of Rs, much more abundant on vein R_5 and all outer branches of M. Venation: Sc_1 ending opposite fork of Rs, Sc_2 at tip; Rs in alignment with basal section of R_5; anterior branch of Rs very strongly arcuated to nearly perpendicular at origin, thus running relatively close to vein R_1, as in *Elephantomyodes*, but arcuated along posterior border of stigma; branches of Rs widely divergent, cell R_3 at margin thus very wide; vein M at origin arched cephalad, greatly narrowing cell R above it; cell 1st M_2 large, rectangular, nearly as long as vein M_{1+2} beyond it; m-cu at near one-fourth length of cell, a little shorter than distal section of Cu_1; cell 2d A wide.

Abdomen short, bicolored, dark brown, caudal margins of intermediate segments pale, of sternites much more broadly so; subterminal segments dark brown; hypopygium pale yellow. One paratype shows the abdominal segments much more unicolorous, tergites brown, sternites a trifle paler. Male hypopygium (Plate 3, fig. 33) with outer dististyle, *od*, bidentate at apex, distal fourth with microscopic spines. Inner dististyle, *id*, longer, entirely pale, gradually narrowed to blunt tip. What appears to represent the lateral arms of the tergite are flattened elongate pale blades, their tips obtuse, contiguous or decussate on median line with the mate of opposite side. Phallosome very pale, relatively short, lateral pale apophyses straight; ædeagus not a coiled penefilum as in typical *Elephantomyia*.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*). Paratopotypes, 3 males.

The only other Oriental *Elephantomyia*, s. s., is *Elephantomyia* (*Elephantomyia*) *pendleburyi* Edwards (Malay Peninsula, Borneo), an entirely different fly. The venation of the radial field of the present insect much suggests the subgenus *Elephantomyodes*, but I prefer to consider the insect a true *Elephantomyia* though aberrant.

ERIOPTERINI

CLYDONODOZUS XANTHOPTERA sp. nov. Plate 1, fig. 18.

Mesonotal præscutum and scutum brownish yellow, darker laterally; head grayish white; scutellum brownish black to black; pleura black, heavily dusted with silvery; halteres yellow; legs yellow, femora with a blackened subterminal ring; wings yellow, with a restricted dark-brown pattern; R_{2+3+4} preserved as a short element; abdomen yellow, with a narrow lateral black stripe.

Male.—Length, about 13 millimeters; wing, 10.

Female.—Length, about 14 to 15 millimeters; wing, 11 to 11.5.

Rostrum dark brown; palpi 4-segmented, outer two segments shortest, crowded; basal segments brownish yellow, outer two segments black. Antennæ with scape brown, very sparsely pruinose; pedicel yellow, flagellum brownish black; flagellar segments cylindrical, with long conspicuous verticils that much exceed segments in length. Head heavily dusted with grayish white, most conspicuous on wide anterior vertex; postgenæ less heavily dusted.

Mesonotal præscutum and scutum brownish yellow, polished, central portion paler; a small black lateral spot behind transverse suture; scutellum brownish black to black, parascutella pale; mediotergite brown. Pleura black, very heavily dusted with silvery. Halteres yellow, stem a little more obscurely so than knob. Legs with coxæ black basally, pruinose, apices paling to brownish yellow; trochanters obscure yellow; femora yellow, with a conspicuous brownish black ring immediately before apex; tibiæ and basal four tarsal segments uniformly pale yellow, terminal segment darkened. Wings (Plate 1, fig. 18) strongly suffused with yellow, costal region more saturated; small dark-brown spots and seams as follows: Interrupted series along cord and outer end of cell 1st M_2; arculus; origin of Rs; Sc_2; tip of vein R_3; fork of M_{1+2}; paler marginal clouds at ends of veins M_1, M_2, and M_3; a paler brown longitudinal wash in cell 1st A at near midlength of vein; veins yellow, dark brown in infuscated portions. Venation: Cell C wide, especially in male; Rs angulated and short-spurred at origin; R_3 in longitudinal alignment with Rs, leaving a short element representing R_{2+3+4}; vein R_4 decurved at apex; cell 1st M_2 relatively small; cell M_1 subequal in length to its petiole.

Abdomen yellow, with a narrow lateral black stripe; hypopygium yellow.

Habitat.—Eastern Borneo.

Holotype, male, Batanbessi, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotype, female, Pelawau berar, Sangkoelirang district, May, 1937. Paratopotype, 1 female.

From the species of *Clydonodozus* hitherto made known from the East Indian islands, including *C. curvinervis* Edwards (North Borneo), *C. griseiceps* de Meijere (Simalur), *C. multistriatus* Enderlein (Sumatra), and *C. punctulatus* Edwards (Sumatra), the present fly differs in the combination of characters as diagnosed above, notably the coloration of antennæ, head, mesonotum, and legs. It is apparently closest to *curvinervis*, differing in the coloration of the head, legs, halteres, wings, and abdomen.

LIPSOTHRIX ASSAMICA sp. nov. Plate 1, fig. 19.

Thorax entirely pale yellow, unmarked; antennæ (male) relatively long, if bent backward extending about to the wing root; halteres yellow throughout; wings subhyaline, prearcular and costal regions clear light yellow; complete series of macrotrichia on all longitudinal veins beyond cord; R_{2+3+4} and anterior branch of Rs subequal; basal section of R_5 angulated and weakly spurred at near midlength; cell M_2 open by atrophy of m; cell M_3 about twice its petiole; m-cu at fork of M; cell 2d A relatively wide; abdominal tergites brownish black, caudal and lateral margins of segments yellow; basal sternites clear light yellow, outer segments uniformly blackened.

Male.—Length, about 5.5 millimeters; wing, 6.3.

Rostrum obscure yellow; palp brownish black. Antennæ (male) relatively long, if bent backwards extending to wing root; scape and pedicel yellow; basal segment of flagellum brownish yellow, succeeding segments black; flagellar segments subcylindrical, with an abundant white pubescence; verticils sparse, shorter than segments. Head yellow.

Mesonotum and pleura entirely pale yellow, unmarked. Halteres yellow throughout, stem relatively slender. Legs with coxæ and trochanters pale yellow; remainder of legs broken. Wings (Plate 1, fig. 19) subhyaline, prearcular and costal region clear light yellow; stigmal area scarcely darkened and entirely undelimited; veins brown, those in the yellow areas luteous. Costal fringe short; complete series of macrotrichia on all longitudinal veins beyond cord. Venation: Sc_1 ending shortly before fork of Rs, Sc_2 at its tip; Rs relatively long, about one-third longer than R_{2+3+4}; R_{1+2} and R_2 subequal, both very pale to nearly evanescent, former about twice as long as R_{2+3}; R_{2+3+4} unusually

long, subequal to entire anterior branch of Rs; basal section of R_5 angulated and weakly spurred at near midlength; cell M_2 open by atrophy of m; cell M_3 about twice its petiole; m-cu at fork of M; cell 2d A relatively wide.

Abdominal tergites brownish black, caudal and lateral margins of intermediate segments yellow, the amount increasing on segments five and six; outer segments uniformly blackened; basal sternites clear light yellow; hypopygium brownish yellow.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 feet, May, 1936 (*Sircar*).

Lipsothrix assamica is readily told from all described Asiatic species by the venation, especially the subequal R_{2+3+4} and anterior branch of Rs, and by the open cell M_2.

TRENTEPOHLIA (PLESIOMONGOMA) CALLINOTA sp. nov. Plate 1, fig. 20.

Mesonotal præscutum yellow, color almost obliterated by blackened areas; median præscutal stripe with central portion of anterior half more reddish brown; flagellar segments long-cylindrical, about four times as long as thick; all tibiæ white, with a slightly indicated dark ring on basal third; wings whitish subhyaline, prearcular and costal portions clearer yellow, including veins; wing tip infuscated.

Female.—Length, about 11 millimeters; wing, 6.5.

Rostrum and palpi black. Antennæ with scape and pedicel brownish black, a little paler beneath; basal three or four flagellar segments brown, remainder black; antennæ relatively long, flagellar segments cylindrical, approximately four times as long as thick; terminal segment about one and one-fourth length of penultimate. Head behind yellow, with a paler median carina that is a caudal elongation of the narrow anterior vertex.

Cervical region dark brown. Pronotum brownish black. Mesonotal præscutum with the restricted ground color yellow, surface almost covered by dark; median stripe brownish black, central portion on anterior half paling to reddish brown; entire lateral margin of præscutum broadly polished black, including humeral region, as well as widened posterior portions, crossing suture and including scutal lobes; median area of scutum yellow; scutellum infuscated, restrictedly pale on caudal border; mediotergite black. Pleura and pleurotergite light yellow, ventral sternopleurite darkened. Halteres brownish black, extreme base of stem pale. Legs with all coxæ and trochanters pale yellow; femora yellow basally, deepening to brown outwardly,

tips abruptly and rather broadly (about 1 millimeter) snowy white; tibiæ white, slightly infuscated just beyond base, the amount including about one-third to one-fourth total length of segment; tarsi white, outer segments a trifle darkened; femora and tibiæ without spines but with scattered long black setæ. Wings (Plate 1, fig. 20) narrow; whitish subhyaline, prearcular and costal regions clearer yellow; stigma small, dark brown; wing tip conspicuously infuscated; scarcely evident darkenings at origin of Rs and on m-cu; veins dark brown, yellow in luteous areas. Venation: Sc_1 ending shortly before R_2, latter subequal to R_{1+2}.

Abdominal tergites brownish black, paler laterally; sternites paler brown, subterminal sternite black; genital segment obscure yellow.

Habitat.—Eastern Borneo.

Holotype, female, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

Trentepohlia (*Plesiomongoma*) *callinota* is most similar to *T.* (*P.*) *candidipes* Edwards, of the Malay Peninsula, differing especially in the coloration of the thorax, legs, and wings, and in the structure of the antennæ.

GONOMYIA (LIPOPHLEPS) PHORACANTHA sp. nov. Plate 1, fig. 21; Plate 3, fig. 34.

Belongs to the *nubeculosa* group, allied to *pallidisignata;* general coloration plumbeous black; scutellum yellow, with a darkened median spot at base; pleura with a narrow pale longitudinal stripe; femoral rings broad, black; wings infumed, variegated with white; cell R_1 relatively wide; male hypopygium with inner dististyle bearing a slender spine at base; phallosome consisting of two simple curved spines arising from complex basal rods and plates.

Male.—Length, about 3 millimeters; wing, 3.2.

Rostrum and palpi black. Antennæ with basal segments yellow above, darker beneath; flagellum black, with very long verticils. Head yellow, center of vertex darkened.

Lateral pretergites narrowly pale yellow. Mesonotal præscutum and scutum plumbeous black; scutellum bright yellow, base darkened on median portion, parascutella black; mediotergite plumbeous black. Pleura almost uniformly plumbeous black, with a narrow and ill-defined whitish longitudinal stripe extending from and including fore coxæ, reaching base of abdomen. Halteres yellow, knobs darkened basally above. Legs with fore and hind coxæ pale, midcoxæ black with the apices restrictedly

pale; trochanters yellow; femora brownish yellow with a broad black subterminal ring, preceded and followed by much narrower, clearer yellow rings; tibiæ and tarsi obscure yellow, outer tarsal segments more darkened; claws simple. Wings (Plate 1, fig. 21) strongly suffused with brown, prearcular field, broad costal border, wing tip, and distal ends of outer medial and cubital cells white; a small darker brown spot at tip of Sc and origin of Rs; stigma brown, a trifle darker than ground color; veins brown, whitened in ground color. Venation: Sc_1 ending immediately beyond origin of Rs, Sc_2 at its tip; Rs and R_{2+3+4} somewhat distant from R_1, so cell R_1 is relatively wide; vein R_3 nearly perpendicular; cell R_2 at margin more extensive than cell R_3; m-cu at fork of M.

Abdomen black, caudal borders of outer tergites pale; hypopygium dark. Male hypopygium (Plate 3, fig. 34) with outer dististyle, *od*, a simple darkened, gently curved rod, with a weak flange on mesal face of basal half. Inner dististyle, *id*, pale, with a conspicuous pale spine at base, this spine about one-fourth length of outer dististyle. Phallosome, *p*, consisting of two slender simple curved spines about one-half length of outer dististyle, arising from a complex series of blackened rods and plates, as illustrated.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*).

The nearest ally of the present fly is *Gonomyia* (*Lipophleps*) *pallidisignata* Alexander (Luzon), which has the hypopygium somewhat similar in construction, the inner dististyle having a conspicuous basal spine forming an apparent additional or intermediate dististyle. The present fly differs from *pallidisignata* in the details of coloration but especially in the phallosome, the outer rods consisting of straight, daggerlike points from an inconspicuous sclerotized basal scaffolding. *G.* (*L.*) *nubeculosa* de Meijere is again quite distinct, the inner dististyle being unarmed and the phallosome again different, the outer rods being long and powerful, subequal in length and size to the outer dististyle.

STYRINGOMYIA REDUCTA sp. nov. Plate 1, fig. 22; Plate 3, fig. 35.

General coloration black, including halteres and legs; setæ of head and mesonotum relatively small and weak; wings with a strong blackish tinge; anterior branch of Rs oblique, unusually long, nearly one-half as long as Rs alone; m-cu a trifle more

than its own length beyond fork of M; vein 2d A simple; male hypopygium without spines on basistyle; dististyle complex, outer arm unusually reduced in size; ædeagus with distal end resembling head of a sea horse.

Male.—Length, about 6 millimeters; wing, 5.2.

Rostrum and palpi black. Antennæ with the scape and pedicel obscure yellow beneath, remainder of organ black. Head obscure yellow, variegated with brown, including a large area in center of posterior vertex; setæ inconspicuous.

Pronotum very pale yellow, darkened in the depressed central portion. Lateral pretergites pale yellow. Mesonotal præscutum black, surface dull, sparsely pruinose; restricted humeral region orange-yellow; setæ relatively small and inconspicuous; posterior sclerites of notum dark, central portion of scutellum and lateral portions of mediotergite a little paler; scutellum with erect setæ. Pleura dull black. Halteres and legs black throughout. Wings (Plate 1, fig. 22) with a strong blackish tinge, base vaguely paler; veins dark brown. Costal fringe of moderate length. Venation: Anterior branch of Rs oblique, unusually long, nearly one-half as long as Rs alone; cell 2d M_2 barely sessile; m-cu a trifle more than its own length beyond fork of M; vein 2d A long and simple.

Abdomen, including hypopygium, black throughout; segments with abundant dense erect setæ. Male hypopygium (Plate 3, fig. 35) without spines on basistyle, *b*. Dististyle with the outer arm, *od*, unusually reduced, only about one-half as long as longest lobe of intermediate style, very slender, setæ correspondingly small and weak; intermedite arm, *md*, long, stout, cylindrical, with numerous coarse setæ, at base with a blackened mushroom-shaped lobe; inner arm, *id*, elongate, pale, gradually narrowed to a short blackened point, surface with abundant long delicate setæ; at base of style a cylindrical blackened lobe. A further appendage, apparently of the dististyle, appears as a strongly curved dark arm superimposed against basistyle. Ædeagus, *a*, resembling head of a sea horse, *Hippocampus*, crown with two small black spines, surface with abundant setæ.

Habitat.—Mindanao.

Holotype, male, Mount Apo, Galog River, altitude 6,000 feet, October 1, 1930 (*Clagg*).

Styringomyia reducta is entirely distinct from the other described black species of the genus that have the legs and halteres

uniformly black. The male hypopygium shows very distinct structural features.

STYRINGOMYIA GEMINATA sp. nov. Plate 1, fig. 23; Plate 3, fig. 36.

General coloration of notum brownish yellow, variegated with brown; antennal flagellum black throughout; knobs of halteres yellow; legs yellow, ringed with brown, rings complete and well-defined; wings yellow with many of the veins black; anterior branch of Rs relatively short, oblique; abdominal tergites bicolored, yellow, caudal margins dark brown; male hypopygium with basistyle terminating in two slender spinous setæ that arise from a single low tubercle; sternite narrow, two setæ placed close together at apex.

Male.—Length, about 8.5 millimeters; wing, 5.2.

Female.—Length, about 6 millimeters; wing, 4.5.

Rostrum pale; palpi black. Antennæ with scape yellow above, blackened beneath; remainder of organ black; flagellar segments cylindrical, with conspicuous verticils. Head chiefly ochreous, with conspicuous setæ, some modified.

Mesonotal præscutum brownish yellow, with dark markings especially on posterior half; scutal lobes yellow, their posterior margins brown; scutellum yellow, bordered posteriorly by black; mediotergite black, paler laterally; mesonotum with some erect modified setæ. Pleura variegated yellow and black, pale yellow ventrally. Halteres with knob and base of stem yellow, remainder of stem darkened. Legs with coxæ and trochanters pale yellow; remainder of legs yellow, conspicuously ringed with brown, as common in the genus, rings complete and well-delimited. Wings (Plate 1, fig. 23) with a strong yellow tinge; veins yellow, following veins black: Anterior branch of Rs; r-m; M and its outer branches; m-cu; tips of veins R_5 to 2d A, inclusive, on last-named vein including about distal half; a distinct cloud surrounding r-m. Costal fringe erect, conspicuous. Venation: Anterior branch of Rs relatively short, oblique; cell 2d M_2 barely sessile.

Abdominal tergites bicolored, segments yellow, conspicuously ringed caudally with dark brown, central portion of basal ring very faintly suffused with dusky; sternites yellow, caudal margins of segments faintly darkened. Male hypopygium (Plate 3, fig. 36) with apex of basistyle, *b*, bearing a low tubercle that terminates in two long slender black setæ. Dististyle, *d*, with outer arm, *od*, uniformly blackened, with weak setæ. Tergite,

t, with apical lobe broadly and evenly rounded, densely setulose. Sternite, *s*, narrow, with two long apical setæ, these placed less than their own width apart.

Habitat.—Eastern Borneo.

Holotype, male, Pelawau berar, Sangkoelirang district, in swampy forest, May, 1937 (*Walsh*). Allotopotype, female.

From the other members of the genus *Styringomyia* having bispinous basistyles, including *S. acuta* Edwards, *S. armata* Edwards, *S. claggi* Alexander, *S. curvispina* Edwards, *S. ensifera* Edwards, *S. holomelania* Alexander, *S. spathulata* Alexander, and probably *S. transversa* Edwards, the present fly is readily told by the structure of the male hypopygium, especially the location of both spines on a common tubercle. The other species, with the exception of the entirely distinct *holomelania*, have these spines arising from individual tubercles and further have the details of the dististyle quite distinct.

STYRINGOMYIA ANGUSTITERGATA sp. nov. Plate 1, fig. 24; Plate 3, fig. 37.

General coloration yellow, variegated with brown; antennal flagellum yellow; dark rings on legs incomplete; wings yellow, with a restricted dark pattern; vein 2d A simple, its distal fourth blackened; male hypopygium with spine of basistyle single, flattened, shorter than its long basal tubercle; tergite with terminal lobe long and narrow, with a dense clothing of long erect setæ; sternite terminating in two short blackened points, separated by a U-shaped median notch, modified setæ subapical.

Male.—Length, about 7 millimeters; wing, 5.

Female.—Length, about 6 millimeters; wing, 4.6.

Rostrum yellow; palpi bicolored, ringed yellow and brown. Antennæ with scape yellow, especially above; pedicel pale brown; flagellum yellow. Head yellow; bristles proclinate, moderately stout.

Pronotum yellow medially, darkened on sides. Mesonotal præscutum chiefly yellow, anterior third a little more darkened, posterior portion nearly clear, median stripe delimited only in front, becoming obsolete behind; lateral stripes reduced to small dark spots at suture; scutum yellow, each lobe with two small isolated brown areas; scutellum yellow, with two erect setæ; mediotergite weakly darkened. Pleura pale yellow. Halteres yellow. Legs with coxæ and trochanters yellow; remainder of legs pale yellow with the usual dark rings on femora and tibiæ, these narrow and interrupted on lower faces of segments; tips of tibiæ and individual tarsal segments darkened. Wings (Plate

1, fig. 24) pale yellow, with a restricted dark pattern on veins, as follows: r-m, involving the adjoining portion of membrane; m-cu; outer end of cell 1st M_2; distal fourth of vein 2d A; veins very pale yellow, darkened as described. Venation: Anterior branch of Rs oblique; r-m just beyond fork of Rs, basal section of R_5 short to virtually lacking; cell 2d M_2 very short-petiolate to virtually sessile; m-cu close to midlength of cell 1st M_2; vein 2d A simple but with tip bent strongly into margin.

Abdominal tergites yellow with small paired dark spots before midlength and with caudal border insensibly darkened; on subterminal segments the brown more extensive to form a continuous median vitta; in the female the pattern heavier, consisting of two pairs of dark spots as described; sternites more uniformly yellow. Male hypopygium (Plate 3, fig. 37) with the spine of basistyle, *b*, single, relatively short and flattened, arising from a long basal tubercle that exceeds it in length. Dististyle, with outer arm, *od*, long, outer margin darkened; remainder of dististyle as figured, intermediate arm, *md*, produced into a long spine, inner arm with two shorter stout blackened points. Tergite, *t*, with terminal lobe unusually long and narrow, its length many times its greatest width, surface squamose, with abundant erect setæ, all exceeding width of blade. Sternite, *s*, depressed, apex with two short blackened points, separated by a small U-shaped notch, usual paired setæ placed subapically.

Habitat.—Philippine Islands.

Holotype, male, Calanag; in the Museum of Comparative Zoölogy, Cambridge, Massachusetts, through Dr. Nathan Banks. Allotopotype, female. Paratopotype, female.

Styringomyia angustitergata is quite distinct from all known species of the genus. The structure of the male hypopygium, especially of the tergite and sternite, readily separates the fly from all described allies.

ILLUSTRATIONS

[*a*, Ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *id*, inner dististyle; *md*, intermediate lobe of dististyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

Plate 1

Fig. 1. *Eutanyderus oreonympha* sp. nov., venation.
2. *Dolichopeza* (*Oropeza*) *fokiensis* sp. nov., venation.
3. *Tipula* (*Schummelia*) *bicolorata* sp. nov., venation.
4. *Limonia* (*Libnotes*) *citrivena* sp. nov., venation.
5. *Limonia* (*Geranomyia*) *torta* sp. nov., venation.
6. *Helius* (*Helius*) *pavoninus* sp. nov., venation.
7. *Helius* (*Helius*) *ctenonycha* sp. nov., venation.
8. *Helius* (*Helius*) *nigricapella* sp. nov., venation.
9. *Gynoplistia* (*Gynoplistia*) *albizonata* sp. nov., venation.
10. *Hexatoma* (*Eriocera*) *perornata* sp. nov., venation.
11. *Hexatoma* (*Eriocera*) *perlunata* sp. nov., venation.
12. *Hexatoma* (*Eriocera*) *nimbipennis* sp. nov., venation.
13. *Hexatoma* (*Eriocera*) *enavata* sp. nov., venation.
14. *Hexatoma* (*Eriocera*) *azurea* sp. nov., venation.
15. *Hexatoma* (*Eriocera*) *disjuncta* sp. nov., venation.
16. *Hexatoma* (*Eriocera*) *juxta* sp. nov., venation.
17. *Elephantomyia inulta* sp. nov., venation.
18. *Clydonodozus xanthoptera* sp. nov., venation.
19. *Lipsothrix assamica* sp. nov., venation.
20. *Trentepohlia* (*Plesiomongoma*) *callinota* sp. nov., venation.
21. *Gonomyia* (*Lipophleps*) *phoracantha* sp. nov., venation.
22. *Styringomyia reducta* sp. nov., venation.
23. *Styringomyia geminata* sp. nov., venation.
24. *Styringomyia angustitergata* sp. nov., venation.

Plate 2

Fig. 25. *Dolichopeza* (*Oropeza*) *fokiensis* sp. nov., male hypopygium.
26. *Tipula* (*Schummelia*) *bicolorata* sp. nov., male hypopygium, lateral aspect.
27. *Tipula* (*Schummelia*) *bicolorata* sp. nov., male hypopygium, tergite.
28. *Limonia* (*Libnotes*) *citrivena* sp. nov., male hypopygium.
29. *Limonia* (*Geranomyia*) *torta* sp. nov., male hypopygium.
30. *Helius* (*Helius*) *pavoninus* sp. nov., male hypopygium.
31. *Helius* (*Helius*) *ctenonycha* sp. nov., male hypopygium.
32. *Helius* (*Helius*) *nigricapella* sp. nov., male hypopygium.

Plate 3

Fig. 33. *Elephantomyia inulta* sp. nov., male hypopygium.
34. *Gonomyia* (*Lipophleps*) *phoracantha* sp. nov., male hypopygium.
35. *Styringomyia reducta* sp. nov., male hypopygium.
36. *Styringomyia geminata* sp. nov., male hypopygium.
37. *Styringomyia angustitergata* sp. nov., male hypopygium.

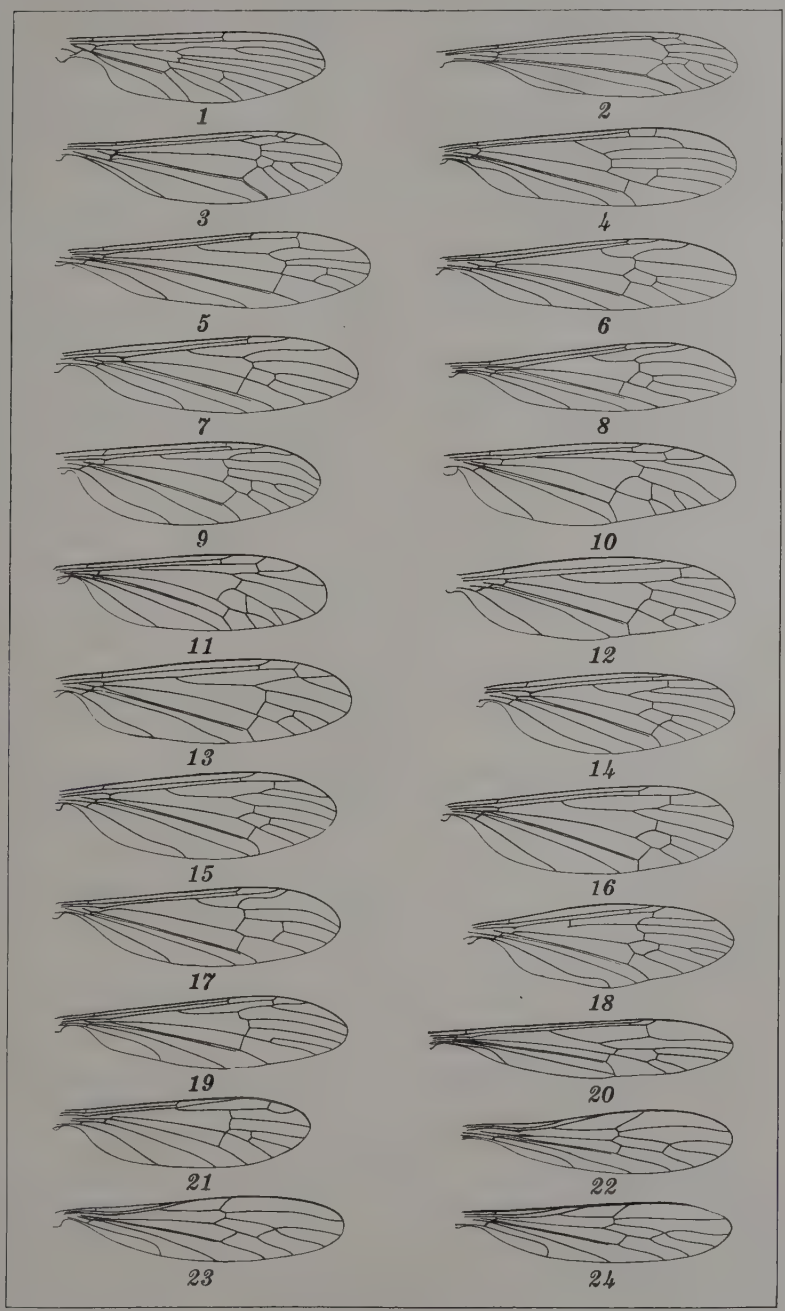

PLATE 1.

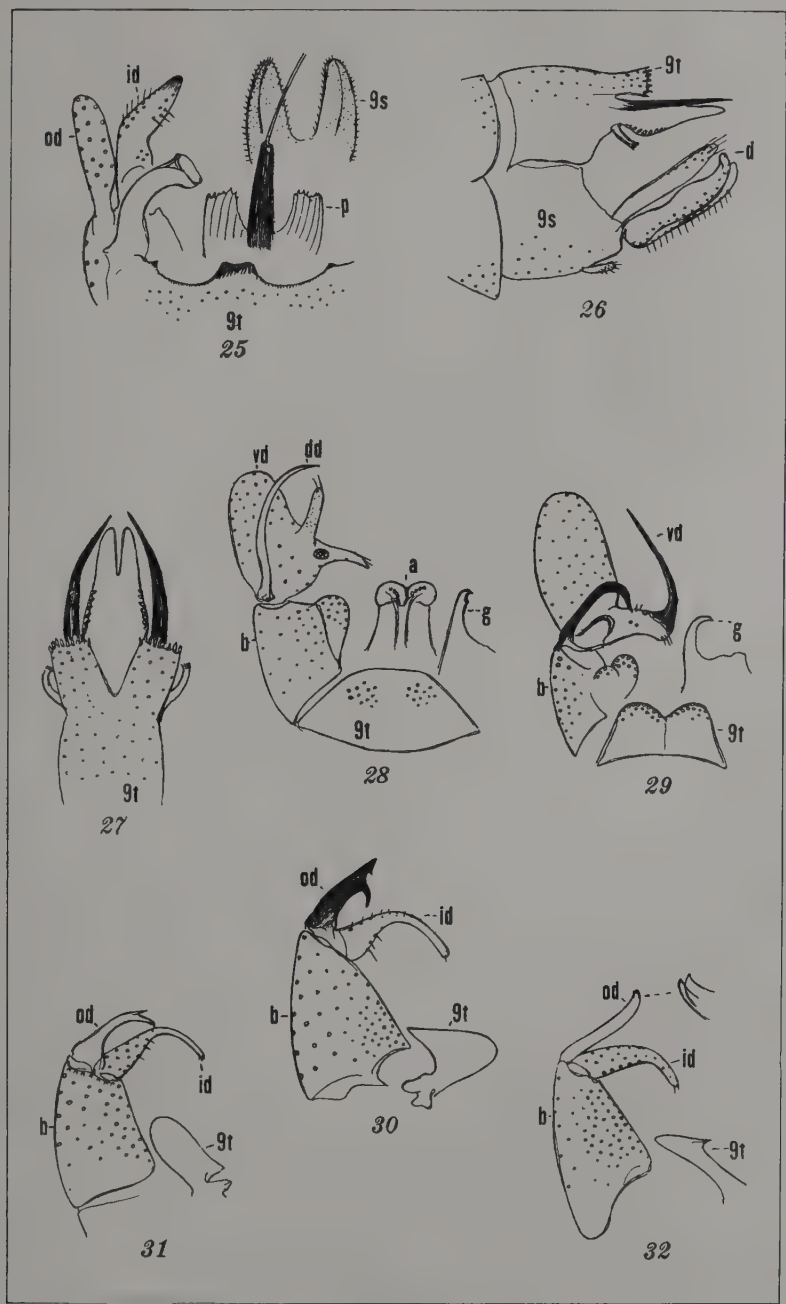
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PLATE 2.

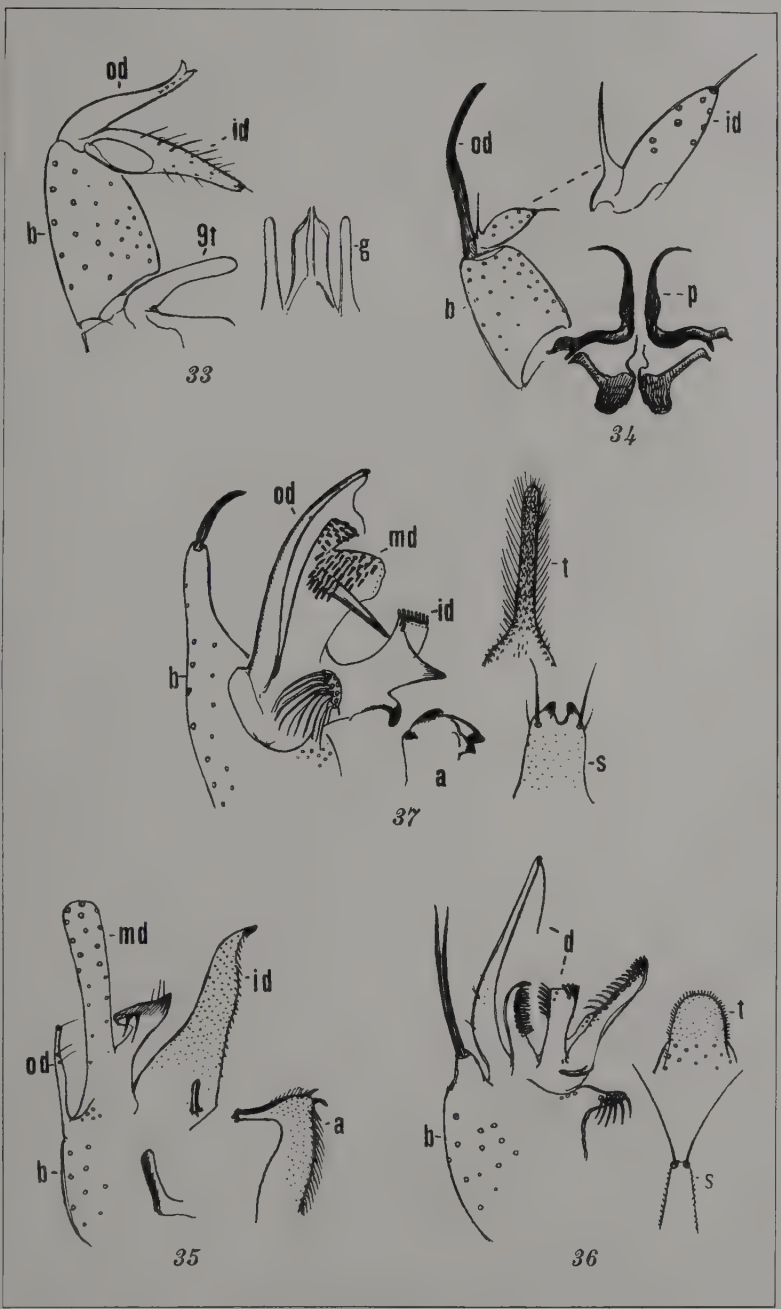

PLATE 3.

A NEW TÆNIOID FISH FROM OCCIDENTAL NEGROS

By Hilario A. Roxas and Guillermo L. Ablan
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TWO PLATES

The genus *Leme*, created by de Vis in 1833 with *Leme mordax* as type, was differentiated from the genus *Tænioides* Lacépède "in having prominent ridges of papillæ on the head." Koumans, in his revision of the genera of gobioid fishes (1931) compared the type of the genus *Tænioides* (*T. hermannianus*), which he actually saw, with the figures of *Leme purpurascens* de Vis and *Leme mordax* de Vis, as pictured by McCulloch and Ogilby (1919). He found the ridges of papillæ as having the same locations and extent in the three species. It seems, therefore, safe to assume that the genus *Leme* de Vis is a synonym of *Tænioides* Lacépède. This genus is close to *Gobioides* Lacépède (1800) from which it differs in having barbels but no scales and having a greater number of rays in the vertical fins. *Tænioides* also differs from *Nudagobioides* Shaw (1929) in having barbels on the chin, in having smaller pectorals and caudals, and in not having externally visible myotomes.

TÆNIOIDES CANISCAPULUS sp. nov.

Head 8.2; depth 13; dorsal VI–42; anal 41.

Body stout, the anterior portion subcylindrical, the posterior laterally compressed; greatest depth at ventral slit to dorsal fin; pores in series present along lateral side of body.

Head blunt, width slightly less than depth, ridges of papillæ raised. Profile from chin to lower jaw bulldoglike. Mouth wide, subvertical, 2 in head; lips thick, fleshy, expanded into broad pads and very much enlarged at angles of mouth, especially the upper ones, with more prominent sensory papillæ. Teeth of upper jaw in five series; those of outer (exposed) rows of subulate teeth the first with 3 incurved teeth on tip of snout, the middle tooth smaller and shorter than the outer two; under or behind the first 14 teeth widely separate, teeth of inner series villiform, closely set, short, pointed. Teeth in the lower jaw in five rows; the outermost row composed of 9 prominent in-

curved teeth; the inner rows of small and pointed teeth; teeth absent on lower terminals of lower jaw. Chin distinctly and obtusely arched, with 3 pairs of short coarse barbels below symphysis; a single barbel present between the middle pair; above the chin a groove. Branchiostegals 5; gill opening as wide as caudal; gillrakers 10, short and tuberclelike; a series of 13 sensory papillæ present from a little above the origin of the fifth branchiostegal to the first barbel, other sensory papillæ also present behind upper jaw; eyes concealed.

Dorsal and anal densely enveloped in a very thick, tough skin, continuous with caudal. Origin of dorsal very far advanced of ventral, with length 1.2; anal higher than dorsal, with length 1.6; its junction with the caudal marked by a deep and conspicuous notch. Pectorals short, small and rounded, 3 in head. Ventrals broad and long, width less than one-half length. Caudal lanceolate, with length equal to head.

Color in life yellowish, in spirit body ash gray, dorsal and anal grayish.

The presence of an extra series of teeth at the tip of the snout and semiserrated anal margin distinctly characterizes the present species from any other species of the genus.

Here described from type specimen No. 41349, 256.5 millimeters long, the only specimen obtained from a burrow by the side of the dike of the Government Experimental Fish Farm, Hinigaran, Occidental Negros, Philippine Islands, November 15, 1936, by the junior author. The specimen is kept in the ichthyological collection of the Fish and Game Administration of the Bureau of Science, Manila.

Caniscapulus, dog-head.

Measurements.—Total length, 256.5 millimeters; standard length, 228.5; depth of body at anal origin, 17.5; length of head, 28; width of head, 19; depth of head, chin to dorsal side, 20; width of mouth, 14; width of gill opening, 11; length of pectoral, 9; width of pectoral, 6.5; length of ventral, 22; width of ventral at second ray, 13; length of caudal, 28; width of caudal, 11; height of caudal base, 8; length of dorsal, 190; height of dorsal, 5.5; length of anal, 140; height of anal, 7; snout to origin of dorsal, 47; snout to origin of anal, 82; pectoral base to tip of ventral, 27; ventral tip to first anal ray, 27; lower jaw to chin, 19.5; chin to base of ventral, 25.

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ILLUSTRATIONS

[Plate 1 was drawn by Pio Medel.]

PLATE 1

Tænioides caniscapulus sp. nov.; from type.

PLATE 2

FIG. 1. Side view of *Tænioides caniscapulus* sp. nov., from preserved type specimen.

2. Ventral view of head and trunk of *Tænioides caniscapulus* sp. nov.

3. Side view of head and trunk of *Tænioides caniscapulus* sp. nov.

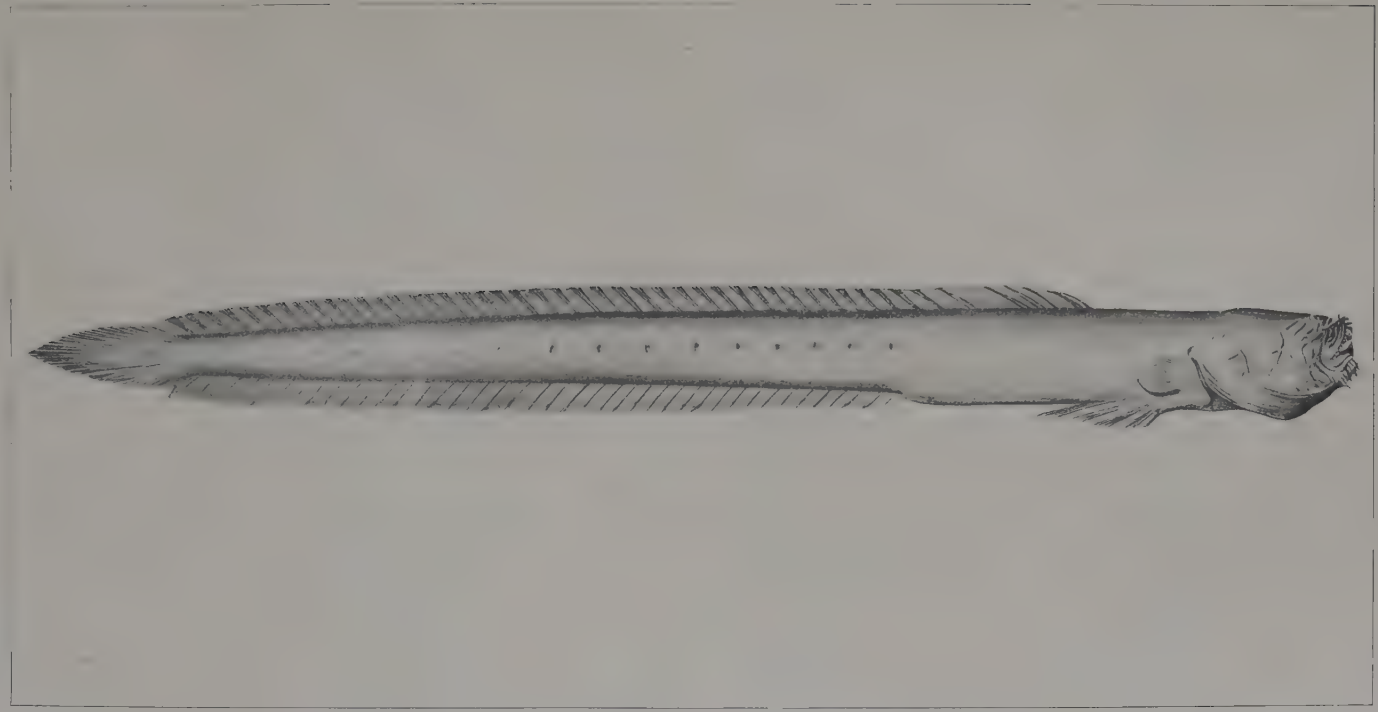

PLATE 1. TÆNIOIDES CANISCAPULUS SP. NOV., FROM TYPE.

PLATE 2. TÆNIOIDES CANISCAPULUS SP. NOV.

THE AVIFAUNA OF THE GIGANTE ISLANDS

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The Gigante Islands[1] are a group of two high islands and several islets and detached rocks, about 10 miles east of Bulacaue Point, the northeastern extremity of Panay. The two high islands, North Gigante and South Gigante, are separated by a narrow channel which at some places is only ½ mile wide.

North Gigante is 758 feet high near the northern end, and wooded. Its area is about 5 square miles, only a very small portion of which is under cultivation.

South Gigante is ½ mile south of North Gigante. It is 763 feet high near the southern end, and well wooded. It is somewhat larger than North Gigante, but its area also is only a few square miles, with only a very small portion under cultivation.

North and South Gigante are very sparsely populated, and most of the inhabitants are fishermen. These fishermen bring their products to Estancia, the nearest town in the mainland, and return to the islands with food supplies, as their crops cannot be depended upon.

There are no means of communication and transportation between the mainland and the Gigante Islands, except the irregularly plying frail sailboats, privately owned by fishermen. During the stormy months, from October to January, only the more daring attempt to cross, thus it is not uncommon for the islanders to suffer from scarcity of food, when no boats carrying food supplies come from the mainland. Transportation being difficult in these parts, it is not surprising that no collector has visited them prior to our recent visit.

Sailing on the government fishing boat, M/L "Science I," Francisco S. Rivera and I were able to do some collecting and observing in these islands. We arrived in North Gigante July 13, 1937, and after 5 days of extensive observation and collecting in both islands, we sailed for the Island of Panay July 17. The present paper contains the results of the collections and observations made on this trip.

[1] U. S. Coast Pilot 1927.

The nomenclature adopted in this paper is taken from: Peters, J. L., "Birds of the World," 2 volumes; Hachisuka, M., "Birds of the Philippine Islands," 4 parts; Kuroda, N., "Birds of the Island of Java," 2 volumes; Chasen F. N., "A Handlist of Malaysian Birds;" McGregor, R. C., "A Manual of Philippine Birds."

BIRDS FROM NORTH GIGANTE

TURNIX SUSCITATOR FASCIATA (Temminck).

One male.

A specimen of the Philippine button quail with imperfect plumage was collected in short-grass tracts of the island. It is indistinguishable from typical *T. s. fasciata* from Luzon.

The native name is *pitao*.

TRERON VERNANS VERNANS (Linnæus).

Four males and one female.

Flocks of pink-necked green pigeons were common, feeding usually on the fruits of *binayoyo* (*Antidesma ghaesembilla* Gaertn.).

The native name is *punay*.

STREPTOPELIA BITORQUATA DUSSUMIERI (Temminck).

One male and four females.

Dussumier's turtle dove was abundant in the scraggy growth throughout the island.

The native name is *tukmo*.

CHALCOPHAPS INDICA INDICA (Linnæus).

One young female.

The Indian bronze-winged dove was always flushed from under the thick bushes that grew profusely along the shore.

RALLUS TORQUATUS TORQUATUS Linnæus.

One male.

The Philippine rail was rather common in the tracts of grass anywhere in the island. A nest with four eggs was found in an open meadow near an idle ricefield. The sitting bird flushed almost from under the feet of the collector.

HETEROSCELUS BREVIPES (Vieillot).

Three males.

The polynesian tattler was often seen in groups of three to five, feeding on the sandy shores of the southwestern part of the island.

DEMIGRETTA SACRA SACRA (Gmelin).

Two females.

The blue reef heron was a common sight along the lonely shores of the island.

Its native name is *dukó*, from its ever-stooping position.

BUTORIDES STRIATUS JAVANICUS (Horsfield).

One female.

The Javan green heron was often seen feeding in association with the preceding species.

The native name is *kioó*.

SAUROPATIS CHLORIS COLLARIS (Boddaert).

One male.

The white-collared kingfisher was very abundant.

The native name is *takray*.

EURYSTOMUS ORIENTALIS ORIENTALIS (Linnæus).

One male and one female.

A few specimens of the broad-billed roller were observed perching calmly on low trees near the clearings.

COLLOCALIA TROGLODYTES Gray.

One male and one female.

There were two species of swifts commonly seen in flight. The present species was most abundant, hundreds being always observed flying in the vicinity of the lighthouse. The natives informed us of caves in which hundreds of these swifts were nesting. The swifts nesting in the vicinity were most likely the present species and *C. francica germani*.

SURNICULUS LUGUBRIS VELUTINUS (Sharpe).

One female.

The single specimen secured of the Philippine drongo cuckoo has some brown feathers scattered through its otherwise black plumage.

The species has not been recorded from the mainland of Panay.

CACOMANTIS MERULINUS MERULINUS (Scopoli).

One male and one female.

The rufous-bellied cuckoo was common.

EUDYNAMYS SCOLOPACEA MINDANENSIS (Linnæus).

Two males.

The Philippine koel was often seen and heard in the thick bushes near the shore.

The native name is *kuhao*.

CENTROPUS BENGALENSIS JAVANENSIS (Dumont).

One female.

The Javan coucal was often heard singing its mournful notes. Several individuals of the species were flushed from the cogon tracts in the hillsides.

YUNGIPICUS MACULATUS (Scopoli).

One female.

F. S. Rivera secured the single specimen of the spotted pygmy woodpecker in a patch of forest.

HIRUNDO TAHITICA ABBOTTI Oberholser.

One male.

Asiatic swallows were common flying low over the shallow waters in the southeastern shore. Frequently several specimens were seen perching together in some dead trees.

HIRUNDO DAURICA STRIOLATA Temminck and Schlegel.

One female.

This species was not as common as the preceding species.

RHIPIDURA JAVANICA NIGRITORQUIS Vigors.

One male.

The black-and-white fantail flycatcher was often met with in the thick patches of vegetation.

The native name is *saya-saya.*

LALAGE NIGRA CHILENSIS (Meyen).

One male and one female.

Several pied lalage were seen feeding on the insects that were swarming around the fruit clusters of binayoyo.

IOLE PHILIPPENSIS GUIMARASENSIS Steere.

Two males.

Steere's bulbul was often seen and heard in the patches of dwarf trees in the hills.

COPSYCHUS SAULARIS MINDANENSIS (Boddaert).

One male.

The Philippine magpie-robin was common in thick growth bordering the shoreline.

MEGALURUS TWEEDDALEI McGregor.

One male.

Tweeddale's marsh warbler was often heard warbling among the thick growth of mixed tall grass and shrubs, but it was difficult to see. The single specimen secured was taken only after the most difficult task of stalking through very thick growth.

ARTAMUS LEUCORYNCHUS LEUCORYNCHUS (Linnæus).

One female.

The native name is *alagit-it.*

DICÆUM PYGMAEUM (Kittlitz).

One male.

This species has not been recorded from Panay.

LEPTOCOMA JUGULARIS JUGULARIS (Linnæus).

Three males and two females.

The yellow-breasted sunbird was common in the swamp growth.

The native name is *tulamís.*

ANTHUS RUFULUS Vieillot.

Two females.

The Indian pipit was commonly observed in the vacant rice fields and in the open grass tracts. Several individuals could be flushed easily from one such spot.

The native name is *tagsing.*

ORIOLUS CHINENSIS CHINENSIS Linnæus.

One male and one female.

The Philippine oriole was often heard and seen.

APLONIS PANAYENSIS PANAYENSIS (Scopoli).

Three males.

Large flocks of these glossy starlings were often met with.

SARCOPS MELANONOTUS Grant.

One male and one female.

The black-backed coleto was occasionally seen in the small coconut patches.

CORVUS CORONOIDES PHILIPPINUS Bonaparte.

One female.

Crows were very abundant. I could always hear their loud cries wherever I went. The birds were nesting in the dwarfed trees high up among the sheer crags in the southern end.

Fifty-seven specimens, belonging to 31 forms, were collected in North Gigante.

BIRDS FROM SOUTH GIGANTE

TRERON VERNANS VERNANS (Linnæus).

One male and two females.

This species was very abundant.

DUCULA ÆNEA CHALYBURA (Bonaparte).

One male.

F. S. Rivera shot the single specimen of Bonaparte's imperial pigeon. He reported seeing several others, but they were difficult to get at.

STREPTOPELIA BITORQUATA DUSSUMIERI (Temminck).

One male and one female.

Dussumier's turtle dove was very abundant.

COLLOCALIA FRANCICA GERMANI (Oustalet).

One male.

This larger species of the swifts was often seen flying about in North and South Gigante Islands. It makes the commercial edible nests. It was more abundant than its congener, *C. troglodytes*.

CACOMANTIS MERULINUS MERULINUS (Scopoli).

Two males.

The two specimens from the island present different plumage.

CENTROPUS BENGALENSIS JAVANENSIS (Dumont).

One female.

As in the northern island, the species was often met with in cogon growth.

ANTHUS RUFULUS Vieillot.

One male.

Several individuals were seen in the idle rice fields.

APLONIS PANAYENSIS PANAYENSIS (Scopoli).

Two males.

This species was very abundant in the island.

SARCOPS MELANONOTUS Grant.

One female.

The black-backed coleto was more abundant in the southern island than in the northern.

Fourteen specimens, belonging to 9 forms, were collected in South Gigante Island.

BIRDS OBSERVED BUT NOT COLLECTED IN THE GIGANTE ISLANDS

MEGAPODIUS sp.

The species has not been seen but footprints unmistakably belonging to a megapode were rather common in the sandy beaches of both islands, especially in places that border thick

growth. We dined one time on eggs that were unmistakably tabon eggs. The natives secured them in the sandy beaches of the islets around North Gigante Island, notably from Gigantuna and Gigantillo.

The native name of the species is *tabon.*

EXCALFACTORIA CHINENSIS LINEATA (Scopoli).

Several island painted quails were flushed in the short-grass tracts of both islands.

EGRETTA GARZETTA NIGRIPES (Temminck).

Several specimens of the little white egret were seen way out in the shallows which surround the islands.

CUNCUMA LEUCOGASTER (Gmelin).

A pair of white-breasted sea eagles were seen perching on the high sheer cliffs in the southern end of North Gigante Island. F. S. Rivera fired at them, but except for the disturbance caused by the loud explosion, the birds were apparently not bothered in the least, for they calmly winged their way to the other island which at this point is only ½ mile away.

HALIASTUR INDUS INTERMEDIUS Gurney.

Two specimens of the Malayan Brahminy kite were often observed in flight over the central part of the island.

TANYGNATHUS LUCIONENSIS LUCIONENSIS (Linnæus).

One specimen of the Philippine green parrot was seen as a pet in one of the houses in the village of South Gigante. The school teacher in the barrio, a bird enthusiast himself, told us that the species was common in the woods of the island but strangely enough has never been seen in North Gigante. Nests of this parrot could be found in the trees of the forest, and the villagers get the young for pets.

ALCEDO ATTHIS BENGALENSIS Gmelin.

A specimen of the Asiatic kingfisher was seen for the first time in a small open creek in North Gigante. Another specimen was observed in a short tree near the shore of South Gigante.

CAPRIMULGUS sp.

One evening three nightjars were seen in flight over the school plaza in North Gigante. One was uttering the characteristic notes of the species. The natives in South Gigante informed us that the bird could be heard evenings in the open meadows near the village.

MEGALURUS PALUSTRIS FORBESI Bangs.

The striated marsh warbler was observed in both islands, although it was more common in South Gigante, particularly in vacant rice fields.

MUNIA ATRICAPILLA MINUTA (Meyen).

Flocks of this weaver were seen in both islands.

Except for the questionable report of the absence of *Tanygnathus l. lucionensis* in North Gigante, all the birds that were either collected or observed in one island were also found in the other.

Three species, *Megapodius* sp., *Megalurus palustris forbesi*, and *Cuncuma leucogaster*, of the birds that were observed, have not been recorded from Panay.

GENERAL CONSIDERATIONS ON THE AVIFAUNA OF THE ISLANDS

Thirty-three forms of birds were collected from North and South Gigante. If the species that were observed but not collected are added to this number, the number of known species in the Gigante Islands will be 43.

Most of the species that have been found in the islands have been recorded from Panay, except *Megapodius* sp., *Cuncuma leucogaster*, *Surniculus lugubris velutinus*, *Megalurus palustris forbesi*, and *Dicæum pygmæum*.

Except *Megapodius* sp. all the above birds have been recorded from Negros and Masbate, which, together with Bantayan, Ticao, and Panay, form the Central Philippine group of McGregor (Dickerson, 1928), based on the similarities of their avifauna.

It is strange that *Megapodius* has not been recorded so far from the important islands of what McGregor (Dickerson, 1928) called the Central Philippine group, except perhaps in Bantayan Island.

SUMMARY AND CONCLUSIONS

The avifauna of the Gigante Islands bears a very close relationship to that of Panay. Most of the species found in the islands have been recorded from Panay, except four, which are however, found in the other islands of the Central Philippine group, and one which has been recorded in one island of the group.

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United States Coast Pilot. Philippine Islands. Part I. Luzon, Mindoro, and Visayas (1927) 209.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

BARRETT, MARY FRANKLIN. A leaf key to Florida broadleaved trees; native and exotic, except palms. The author, c1937. 79 pp.

British Plastics year book, 1938. Handbook and guide to the plastics industry. London, Plastics press, ltd., 1938. 595 pp. Price, 15s.

COLEMAN, HARRY S. Planning and equipping laboratories for research; recent experience at Mellon Institute, 1938. 11 pp.

Glossary of terms relating to rubber, its uses and manufacture. 2d ed. Stamford, Conn., The Stamford Rubber Supply co., 1937. 28 pp.

Mellon Institute. Dedication of the new building to science and humanity for Andrew W. Mellon and Richard B. Mellon. Pittsburgh, Pa., The Institute, 1937. 55 pp.

OSGOOD, EDWIN E., and CLARICE M. ASHWORTH. Atlas of hematology; with three hundred and twenty-five illustrations and a frontispiece in color. San Francisco, J. W. Stacey, inc., c1937. 255 pp.

The physician and our daily bread. N. Y., Dept. of Nutrition of the American Institute of Baking, 1938. 19 pp.

SPRINKLE, LELAND W. Sprinkle's Conversion formulas. Philadelphia, P. Blakiston's Son & Co., inc., c1938. 122 pp.

STROCK, LESTER W. Spectrum analysis with the carbon arc cathode layer. London, Adam Hilger, ltd. 56 pp.

TANNEHILL, IVAN RAY. Hurricanes; their nature and history. Princeton, Princeton University Press, 1938. 257 pp. Price, $3.50.

TRUE, ALFRED CHARLES. A history of agricultural experimentation and research in the United States, 1607–1925. U. S. Department of Agriculture, Miscellaneous Publication No. 251. 321 pp.

REVIEWS

Mechanics, Molecular Physics, Heat, and Sound. By Robert Andrews Millikan, Duane Roller, and Ernest Charles Watson. New York, Ginn and Company, 1937. 498 pp., bibliography, illus., tables. Price, $4.

This book, like Millikan's "Mechanics and molecular physics and heat," is a textbook and a laboratory manual combined. It "stresses a thorough treatment of fundamental principles rather than the presentation of a large mass of facts." It has much interesting historical material which appears either as chapter introduction or plate. Each chapter ends with some experi-

ments, a question summary, and problems. Questions are inserted in the directions for the performance of the experiments, the answering of which will make the student perform the experiment intelligently and help him understand the underlying principle. Calculus is used in some portions of the book, although it is intended "for the serious student who seeks a thorough training in science or engineering, who has already mastered trigonometry and who has had the equivalent of a good secondary school course in physics." Although most of the experiments are the same as those ordinarily given in a first course in college, this book is too difficult to serve as a textbook for a first course in the Philippines. It is more fitted for a second course in college in the Philippines, especially for physics major students, in which case, however, it will have to be used in connection with another book for the laboratory work.

—T. P. A.

Workers' Nutrition and Social Policy. Studies and Reports, Series B (Social and Economic Conditions) No. 23. Geneva, International Labour Office, 1936. 248 pp. Published in the United Kingdom by P. S. King and Sons, Ltd. Distributed in the United States by The World Peace Foundation, 8 West 40th Street, New York City. Price, $1.50.

This report was published by the International Labour Office at Geneva in 1936. It is a fairly detailed survey of the problems of adequate nutrition. The chapter headings indicate the scope of the work. Some of the more important chapters are: Nutrition and Occupation, Facts on Workers' Diet, Agricultural Production and Food Consumption, Social Legislation and Nutrition, Agencies and Methods to Improve Nutrition, Problems of Policy. Important statistical methods and a review of national food regulation appear in the appendices. The work has great merit because it defines the problem as clearly and precisely as possible, and should be read not only by employers and workers but also by legislators and government leaders.

In the chapter entitled "Problems of Policy" the authors of the report state:

> All institutions today, political, economic, charitable and religious, are directly or indirectly interested in the building up of a healthy human race. Whatever the ideal of a people may be, its attainment and promotion require a healthy and vigorous population. It is the recognition of this fact which gives meaning and force to the new crusade for a general nutrition policy not only in times of depression but as an element of national policy akin to and on a par with education, housing and similar public policies.

A social nutrition policy is but another concrete application of one of the general principles upon which the International Labour Organisation is founded, namely, the need for the special protection of those groups of the population which because of poverty or other reasons fall below socially desirable minimum standards. In brief, the measures needed to improve workers' dietaries are part of the general programme of the International Labour Organisation for raising living standards in all countries as a condition *sine qua non* of social justice and peace.

This statement is food for thought on the part of the legislators and the leaders of our government, especially at this time when attention is focused on social justice.—I. C.

Faisceau Energétique et Biologie; Biogenése et Pathogenése. Par le Docteur G. Froin. Paris, Librairie Girardot et Cie, 1937. 327 pp., illus. Price, 30 Frs.

The book of Dr. G. Froin under the title "Faisceau Energetique et Biologie" is an interesting book of physical biology which will be appreciated by both the biologists and the physiologists engaged in the various problems of normal and pathological human life.

Human life, in the words of the author, may be considered a simple "burning without flame" in which the atoms and molecules of visible matter, as well as of invisible energetic matter from our sun, play the most important part.

In the pages of this book are studied the sun's energetic matter, its penetration and distribution in the various tissues, and the rôle played in the different functions of the human organism.

Finally, this biogenetic and functional study is accompanied by interesting remarks or considerations in connection with the pathogenesis of certain human diseases.—C. M.

International Aspects of Oceanography; Oceanographic Data and Provisions for Oceanographic Research. By Thomas Wayland Vaughan and others. Washington, D. C., National Academy of Sciences, 1937. 225 pp., plates, charts.

This book presents oceanographic data with a synopsis of information available for the study of several aspects of the ocean. In addition, some references to literature aside from the lists of sources of data are included. The purpose is to give in a brief form the degree of exploration of as nearly all the areas of the ocean as possible. In this way areas in different oceans on which there is no information are brought out. A catalogue of oceanographic institutions for each country is included, giving the provisions for oceanographic research and the scope of oceanographic activities for each. This arrangement makes clear

what is being done in each country on oceanography, information that may be utilized by countries with inadequate provisions for placing their program of oceanographic studies on the same plane as that of other countries, should they desire to do so. The book should serve as a very useful reference to workers on various aspects of oceanography.—D. V. V.

Hurricanes; their nature and history. By Ivan Ray Tannehill. Princeton, Princeton University Press, 1938. 257 pp., illus. Price, $3.50.

In this book an experienced meteorologist gives to the public an interesting description and explanation of the complicated natural phenomenon called the hurricane. With the resources of the United States Weather Bureau Library at his disposal, he has selected incidents very suitable for illustrating his subject matter. For those who know little or nothing about meteorology the book will be instructive and entertaining. For meteorologists who are familiar with the subject of the book, there is an excellent catalogue of hurricanes of the West Indies, together with a bibliography, both valuable for reference.

The first few pages of the book define the tropical cyclone and give the historical development of the methods by which that definition was formed. The progress made after investigations into the nature and cause of these storms leads up to the present technique in detecting their formation and locating their centers after the storm has formed. Separate chapters discuss the various parts of the hurricane, namely the winds and the "eye," the storm wave, rainfall, and destructive effects. In his treatment of the theories concerning the origin of these storms, the author presents the various ideas as to their cause and maintenance, in which he gives credit to work that has been done along these lines at the Manila Observatory. The ordinary and extraordinary tracks of hurricanes and their varying frequency indicate very well the difficulties forecasters have when these storms occur. The author's explanation of precursory signs is the most practical part of the book and can be read with profit in any part of the world frequented by tropical cyclones.

The final part of the book has an excellent list of hurricanes, from the time of Columbus up to the present. Only the most destructive storms in the early years are described. From the beginning of the nineteenth century, because of more complete records, the list is more numerous. All the hurricanes since the beginning of the twentieth century are mentioned. There is a supplement giving the dates of all known West Indian hur-

ricanes since the time of Columbus. An excellent bibliography concludes the book.

Although most of the examples used by the author are taken from hurricanes in the West Indies, his presentation of the subject matter gives the book general usefulness wherever tropical cyclones occur. In the Philippines a wide distribution of this book would make people more familiar with the nature of a typhoon, or baguio (which is the local name for a tropical cyclone), resulting in a better understanding of the typhoon warnings issued during the progress of the storm.—B. F. D.

Introduction to Research on Plant Diseases; A Guide to the Principles and Practice for Studying Various Plant-Disease Problems. By A. J. Riker and Regina S. Riker. St. Louis, John S. Swift Co., Inc., 1936. 117 pp., illus., charts. Price, $2.65.

This book is a collection of methods in plant pathology, put together by Professor Riker and the junior author. The methods are systematized into eleven chapters: foundation of research problems; general laboratory equipment; culture media; certain physical-chemical measurements; isolation, culture, and inoculation; virus diseases; certain procedure for pathological histology; epidemiology, environment, and control; statistical analyses; records and manuscripts; and laboratory exercise topics.

The methods as presented under different chapters facilitate the work of a student or researcher studying the various phases of a problem. With this book as a guide, the tribulations usually experienced by a student in searching through the mass of literature on methods is greatly minimized. Moreover the methods are selected and tested. The index in the book serves as key to other research procedures. It is of course duly recognized that a researcher may occasionally find it necessary to modify or establish methods suitable to the demands of a problem and available facilities.

The discussion gives a student an insight into the proper approach to and the intricacies of the task before him. With the various points briefly discussed under separate topics, and the methods under the different chapters, research students may be ushered more readily into the various phases of a research problem. Teachers in plant pathology, research students, and investigators will find this book a very useful reference. Professor Riker and the co-author are research pathologists with training, experience, and achievement in pathology possessed by few.

—F. M. C.

Exploration Radiologique des Colons et de L'Appendice au Moyen des Solutions Floculantes. By Georges Maingot, Raymond Sarasin, and Henri Duclos. Paris, Masson et Cie., 1935. 229 pp., illus. Price, $13.

This book has presented modern roentgen-ray study of the colon and appendix by the examination of the colon in three stages or parts. The first stage, which is the most classical technique, is the study of the colon after it has been filled with radio-opaque solution (colloidal solution of thorium dioxide). This stage gives certain information as to the form and condition of the colon, but at times the presence of small growths, polyps, diverticula, or ulceration of the mucosa are missed due to the opaque shadow filling up the whole lumen of the colon. For a complete examination another X-Ray study is made just after the evacuation of the enema, and another after insufflation of air, called the double-contrast method. These last two procedures or parts of the examination are necessary in the demonstration of mucosal morphology.

There are also interesting pictures of the appendix presented.

The technique is well described, and the different morphological conditions of the colon are well discussed and vividly presented by a great number of illustrations that make the book a good reference for the roentgenologist.—P. S. C.

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